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GAS JOURNAL

LIGHT ♦ HEAT ♦ POWER ♦ BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

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EDITORIAL NOTES.

Protected Occupations Schedule—Case of Non-Certified Gas Undertakings—No Cause for Alarm.

WAR service badges, certificates, and trade cards held by the men of those firms and works engaged in producing materials for the Admiralty, War Office, and Ministry of Munitions—including gas undertakings that are providing substances for the manufacture of explosives—are now cancelled; and scheduled occupations or temporary protection certificates will be issued in substitution, in the case of those concerns that have made returns in the short time allowed, for the classes of men described in the new schedule, who are within military age, and not below certain specified ages. There is a point which has created some perturbation in gas management circles, and that is the appearance in the schedule of the word "certified" in connection with gas supply undertakings—*e.g.*, "in cases "where the gas undertakings are *certified* by the Ministry "of Munitions under the Munitions of War Act." The use of the word "certified" is due to a misunderstanding, and is therefore a mistake. There are probably not more than (say) 100 gas-works—and some of them of comparatively small size—that have been "certified" by the Ministry; while there are many hundreds of gas undertakings that are in minor number oil-washing, and in major number tar-washing for the express purpose of serving the Ministry of Munitions. Thus if only those undertakings that have been "certified" received protection within the terms of the new schedule, the greater number of undertakings engaged on the special work of producing explosives would be completely cut-out of the new protection scheme, and the further anomalous condition would arise that, while certified small works that are oil-washing were included, some large ones that are making very important contributions to the supplies of explosives material would be excluded.

But all doubts and fears may be set at rest, and without any question; for, on excellent authority, we understand arrangements have been made whereby *all* gas undertakings to any of whose employees badges have been issued in the past, or who can claim to be engaged upon work for the Admiralty, War Office, or Ministry of Munitions—which would obviously include those supplying gas to factories or institutions engaged upon such work—will receive in all respects similar treatment in the matter of recruitment to that which will (as specified in the Schedule of Protected Occupations) be meted out to those undertakings which have been "certified" by the Ministry of Munitions under the Munitions of War Act. So managers of gas undertakings with badged employees, or of those which are necessary to the continued working of essential war industries, though the works have not been certified, need not worry themselves any more than if the word "certified" had never been printed in the schedule. This is satisfactory. But there are some gas-works of small dimensions that have never had badged employees, certainly have never been "certified," and may not be actually supplying war factories or depots of any kind. It is hardly likely that the position of such works will be in any way affected, seeing that there is little doubt that already from them the men of military age have been taken for serving with the Colours. Be that as it may, any such undertaking has still the same right of appeal to tribunals as before, and can plead the fact, admitted by the Director of National Service, that theirs is an essential industry, the stopping of which would increase the uneconomical consumption of coal and the employment of labour.

This weeding-out of men from industries—including the gas industry—engaged on war work for the Admiralty, the War Office, and the Ministry of Munitions, and the narrowing-down of protection to what is regarded as the absolute essential for carrying on the work (though still subject to future amendment as compelled by the exigencies of the military situation) is an indication of the present pressure for more men for our Armies. And any criticisms of decisions in respect of the gas as of any other industry must be tempered by this consideration. Gas undertakings have not received the complete range of protection that their managers would have liked; but we believe that, on careful examination of the schedule and all its governing general provisoes, few gas managers will find they have serious cause for alarm or anxiety. At any rate, they do know now where they are in respect of the men in the positions described in the schedule who are within military age, and are not below the ages specified. These latter ages may involve the parting with a few skilled and technically qualified young men, unless they (and it is the same with men whose occupations are not specified) can be proved to be "men "who occupy pivotal positions, or have exceptional quali-"fications which render them indispensable." There will no doubt, through the narrowing of the age limits by excluding these younger men, be some resulting gaps; but on the whole the age limits are, in the situation of to-day, not unreasonable—*e.g.*, foremen 23, stokers and main and service layers 25, fitters 28, and *every man in every grade* 32, with *no man of any age to be taken who is not passed for general service* (A). There is not much wrong with protection on these lines, especially when it is borne in mind that for the future the managers of undertakings protected by this arrangement will not have to go to tribunals having in many cases no knowledge or appreciation of the work the gas industry is doing, but to an officer of the Ministry of Munitions who has knowledge, and will be unaffected by local prejudices.

This is, indeed, a very great gain. It should be remembered, moreover, that there has never before been any specific protection for any men outside the works. In fact, we cannot but feel that those who have been handling this question with the authorities for the industry through the National Gas Council, although they have not got all they tried for, have achieved some very valuable results that we believe will be widely appreciated as the facts become known. The two main points on which the authorities have not conceded what was felt to be essential are, the protection of men brought into the industry since Aug. 15, 1915, and the provision of satisfactory substitutes before the enlistment of men who have to go. But it is hoped that this will not prove as serious a matter as some have feared. To fill such gaps as are created in the industry, more women will obviously have to be brought in. But those available for employment are daily becoming scarcer. As in the case of men strange to the work, they have all of them to be trained, and so time is occupied. Those gas managers who have been wise, and have quietly proceeded with the training of substitutes, in view of the probability of the situation becoming more irksome, may congratulate themselves on their foresight and prudence. Though a few weeks' grace, as specified in the official copy of the schedule, is allowed in the case of the men who will be called to the Colours (providing they are medically fit), it is clear that further extension of time will not be permitted. There is a decisive note about this statement: "The need of the "Army is far too urgent to admit of the release of men being "delayed in every case until substitutes have been pro-"vided, and the supply of male substitutes is likely to prove "inadequate to the demand."

The Admiralty, the War Office, and the Ministry of Munitions are responsible for the new schedule; and they are deeply concerned in the maintenance of the output of their requirements. Considering this, the significance of the sifting-out of men from the industries upon which they jointly depend does not require any emphasizing. The gas industry has to make the best of the new situation, which was not altogether unexpected, though not viewed with any comfortable feelings, seeing that, in an industry with such special and varied work, the experienced hands are all more or less "skilled." The loss of the semi-skilled and even of those who are technically called unskilled, yet are possessed of experience and knack, affects the general efficiency; and prior to the present revision and change of system of protection, there had been an immense drain on the industry's man power.

[Since the above article was put in type, it has been officially announced that the new scheme for regulating the release of munition workers for the army will begin to take effect from next Monday, May 7.]

Experiences with Four Hundred B.Th.U. Gas.

When in August last Mr. James E. Enright delivered his Presidential Address to the Irish Association, there were very good grounds for congratulating the inhabitants of Tralee on the possession by the gas-works of a carburetted hydrogen plant. Without it, owing to the irregular deliveries of coal, and sometimes non-delivery, there would all too frequently have been no gas for Tralee; and if coal could have been constantly obtained at the price of 55s. per ton, an all coal-gas supply would have made gas consumption a luxury and a financial burden. Since August the consumers would have been in still more desperate straits, had it not been for the carburetted hydrogen plant; for, to add to the other miseries of working, the town has experienced two floods, and the retort-house has been under water to the height of the bottom retorts. This was a dislocation of working which provides Mr. Enright with an experience in the supply of the neat product of his carburetted hydrogen plant, with a calorific value of about 400 B.Th.U., and makes an interesting feature of an article on "The Economy of "Coke Gasification," which he contributes to our columns this week.

With his further experience of the plant, Mr. Enright has nothing but satisfaction to express, apart from having been to him an indispensable friend in need. The cost of 9d. per 1000 c.ft. for materials and labour over ten months' working confirms the experience in the address—in fact, the cost per 1000 c.ft. over that time is a fraction of a penny lower. But the criticism may be made that the coke gasified is only charged up at 20s. per ton, and tar at 2d. per gallon; and this with coal at 55s. per ton! Mr. Enright, however, is justified; for the coal cost is largely due to extraordinary freight charges, and the awful stuff delivered supplies coke of such poor quality that the carburetted hydrogen plant is placed at a disadvantage. The question of fuel or coal economy is brought into striking relief by two sets of figures: During the ten months, the coal gas made was 14,885,900 c.ft., to produce which 1357 tons of coal were carbonized, costing (as said) 55s. per ton. With the carburetted hydrogen plant, 15,225,100 c.ft. of gas were made, on an expenditure of 363 tons of coke at 20s. per ton and 10,197 gallons of tar at 2d. per gallon. These figures show how Tralee has been financially helped by the new plant, and how coal economy has been served. Had it not been for the plant, more than double the quantity of coal would have had to be purchased at 55s. per ton, shipped, delivered, and handled, and carbonized on the works, while the coke and tar were there—products of the smaller quantity of coal carbonized. One point about the tar. It is understood that dehydrated tar can be used in the plant; but we take it it is not claimed that this can be done with a carburation efficiency as high as that of crude tar.

It is a pity the existing plant is not equal to the maximum day's make, as then Mr. Enright, when deprived of his coal-gas plant, would not have had to reduce the pressure in the district when supplying carburetted hydrogen gas of about 400 B.Th.U. As a matter of fact, the pressure should have been increased to compensate for the 20 p.ct. or so reduction in calorific value of the mixed gas, which is maintained at approximately 500 B.Th.U. Had it been possible to give an increased pressure, the complaints from the borders of the district would have been avoided. However, the experience has its value. Naturally, with this neat gas 100 B.Th.U. less in calorific value than the mixture ordinarily supplied, less air is required for combustion. In engines, fires, and cookers, the consumption is found to be about one-fifth more than when the 500 B.Th.U. mixture is distributed; but this increase is infinitesimal compared with the price that would have had to be paid for gas made from coal at 55s. per ton. It is stated elsewhere that there is experience which shows that the plain gas burns clean and well without any admixture of air, giving a flame reduced in size, but the temperature of which is, in consequence, undoubtedly high. The diminished volume of air introduced into the flame must account for the experience with incandescent burners. Once adjusted for a 50 p.ct. mixture, it is found that they require no further regulation with any proportions (up to "neat") of carburetted hydrogen gas; and with the 400 B.Th.U. gas, because of the reduced air supply, Mr. Enright finds the burners as economical and efficient as with the richer gas. Manufacturers of cooking-stoves should, in view of possible developments, begin to fit them all with air regulators. This is a point to which we have before drawn attention; and it is one that should not be avoided, because it is important. In recent times such provision would have been highly useful; and it will, we anticipate, be found equally so in the future. However, we are obliged to Mr. Enright for his interesting contribution to a subject that many people look upon as being of supreme importance to the industry at the present time.

Blended Gases—Adulterant or Diluent.

Twelve years or so ago, discussion was fairly prolific over the subject of the dilution of coal gas with blue water gas; and prior to that there had been spasmodic interest in the matter through the work of Prof. Vivian B. Lewes, at the Lower Sydenham works of the South Suburban Gas Company. It is fitting that this Company should, as was mentioned by the Chairman (Mr. Charles Hunt) last week in our "Correspondence" columns, be again setting out, at the same works, to investigate the question of economical gas production and use, in the light of recent developments. The advocates of blue water gas twelve to twenty years ago were somewhat before the times; nevertheless to-day, the conditions being changed, there is gratitude for the work they then did, as it gives a certain amount of leading in, though not altogether applicable to, the existing circumstances. The whole question is approached to-day from a new standpoint—a standpoint built-up of considerations internal and external to the industry itself. The luminosity of gas *per se* is now a matter of comparatively small moment except in a few special cases. Calorific power is the recognized standard; and the Government are in favour of the removal of as much as possible of the constituents of gas upon which gas luminosity depends, and are solicitous that this shall be done. These conditions are propitious to the reconsideration of the question; and so are others which were not so urgent a dozen years or so ago as they are to-day. Coal for gas making is dear; it will in future, so everything portends, be dearer than in pre-war times under the normal conditions, subject to the fluctuations due to trade and labour influences. The same with oil. Even our American colleagues are tired of being subservient to the vagrant market ways of oil; and they see coal gas the base of future important developments. These conditions mean that in some way gas-manufacturing economy has to be achieved; and if this can be realized, as we believe it can be, then not only shall we be helping to consolidate the foundations of the industry, but shall be working to national ends in the matter of fuel economy, as well as doing part in relieving the *post*-war coke market.

Various undertakings with water-gas plants—carburetted and simple water-gas generators—have lately been obtaining good experience as to what can be done. It is experience gained by force of circumstances which have compelled the forsaking of the old and the treading of new paths. Blue water-gas has been made by water-gas plants that have hitherto without break been used to produce the carburetted brand of gas, and, in almost all other cases, the price and shortage of oil have necessitated carburetting being confined to a gallon (and in cases less) per 1000 c.ft., instead of the 2 gallons and more of pre-war times. This experience is all to the good; and it is going to serve well in the technical development of our industry, as well as help in the desirable work of displacing the suicidal policy of some gas engineers

in sending out heavy percentages of inert constituents drawn in from the producer gases surrounding their retorts.

A word about this. Such inert constituents cannot, of course, be altogether avoided. With the permeability of retorts and the pressure conditions in retorts and settings, it is inevitable that there will be a certain amount drawn into the gas *plus* that from the coal itself. As we have also said before, with the removal of some of the combustible constituents from the gas by oil or tar washing, this would also slightly increase the proportion of incombustibles in a given volume of gas. But the appalling amount of nitrogen which analyses are disclosing can only be due to the reluctance of some engineers to accept current conditions, and limit their makes to good and true gas, subject to the unavoidable quantity of inert ingredients. The secret of this reluctance, and of the extraordinary nitrogen content of the gas, is the desire to maintain the quantitative high makes (some of which were much too high before) with coal sent from the collieries in an unwashed and unclean condition. Combustible gas cannot be obtained from dross of the character contained in the coal now delivered; and therefore, from a polluting extraneous source, volume is made up by engineers who foolishly have no care for anything so long as their make per ton does not suffer. What is there to be said in defence of inert gases ranging from one-fifth to one-third of the total volume? Fancy manufacturing plant, holders, and mains being saddled with such an uneconomic procedure! Fancy the consumers being saddled with such percentages of useless gas! The interests of the industry do not warrant the hiding of the facts. It is simply no use trying to hide them. They are already in the possession of those who will know how to use them, and who will undoubtedly use them; and then we shall have the spectacle of the gas industry compelled to trade in (as near as may be) an honestly combustible gas, instead of voluntarily doing what the commonsense of those who have proved themselves reactionaries ought to have told them was essential.

Nearly eleven years ago, Dr. Harold G. Colman, in an article written for the "Journal" [Sept. 18, 1906] and in a letter in the issue for Oct. 9 of the same year, warned the gas industry of this. Others have done so since; and the prior discussions as to the effect of nitrogen on flame temperature, and as to the value of a blue water gas as a diluent with its approximately 90 p.ct. of combustible gas, ought to have kept gas engineers to the path where vitiated quality, and a false hall-mark of quality, are not allowed, but where the gas delivered to the consumers is as represented. Nitrogen gives a large volume of flame; the larger the external surface, the cooler must the surface be, and therefore the lower its efficiency for heating purposes, by either contact or radiation. The same is the case if the chemical composition of the gas demands a large introduction of air in order to effect its complete combustion. Flame volume is increased; flame temperature decreased. And the inert gases go to swell the volume of the products of combustion, which are also the vehicles for reducing flame temperature by running off with heat. Using blue water gas as a diluent, flame volume is decreased proportionally to calorific power or even more; and (Dr. Colman, in his contributions to our columns of eleven years ago, gives authority for saying) the flame temperature of the mixed gas is as high as, or higher than, that of the unmixed gas. Of course, the mixture has to be kept within reasonable proportions, depending upon the quality of the coal gas produced. But all the investigation and work that have hitherto been done point to the possibility of the consumer being served with greater economy, and without harm, by blending gas from coal and coke—a practice that developments favour, and hostile uneconomical conditions urge on consideration.

The economies and efficiencies to be derived from stopping adulteration, both for manufacturers and consumers, are obvious. The economies to be produced by displacing by coke a portion of the dearer coal used in manufacture are also obvious. There is talk of the necessity of revising the standards of coal storage in view of the greater uncertainties—*ex*-war time—in regard to labour. The use of coke and the making of blue water gas would stand partly in lieu of increased coal storage. The availability of the gas and the flexibility of the plant economically affects the provision for gas storage. The capital and wear and tear charges on blue water-gas plant are much lower than on coal-gas plant. The case from the economical standpoint appears to us to be very complete for a reconsideration of the practice of a legitimate blending of gases.

Man Efficiency.

We are all agreed now that one of the most important questions connected with the future of our industrial life is that of the efficiency of the craftsman, and that to raise and attain the highest possible efficiency, a start must be made at the very beginning—that is, with the "raw" material, as embodied in the apprentice. At their recent meeting, the members of the Society of British Gas Industries were engaged in considering this aspect of the question; and for the gas industry, whose work, through its very nature, requires skill and a sense of responsibility in those who carry it out—alike at the factories of the manufacturers of gas plant and appliances, and in the distribution department and repair shops of gas-works—the subject is one for very careful thought and action. The matter was introduced by Mr. H. A. Bennie Gray in a paper which was packed tightly with high ideals. But its cardinal feature advocated co-operation in the work of training between the manufacturers of a district and the nearest technical institutions—such as the schemes (referred to in the paper and during the discussion) with which trial is now being made at Huddersfield and Manchester, and a good illustration of which, if it extended to all like apprentices in London, is found in the co-operation between the Gas Light and Coke Company and the Technical School of the London County Council for the training of boys as gasfitters.

Naturally, in such schemes of co-operation as Mr. Bennie Gray favours, the first essential is to get to one mind all those who alone can bring the schemes into effect. Until the manufacturers are converted to a belief in the need for the technical (apart from the practical) education of their apprentices, and recognize the fact that this is the way to the realization of higher man efficiency, it will be difficult to obtain in really effective measure the necessary co-operation. It is a big step gained, however, that there are now employers who are persuaded that the right way for apprentices to secure a thorough technical training is not by leaving them to voluntarily take up studies at technical schools in the evening after they have put in full time during the day at practical work. It is not in the nature of any but, as Professor Smithells would say, the "exceptional" boy, to spend his evenings by choice at school after his ordinary day's work is done. This being so, there is only one alternative; and that is the right way. It is for the masters to provide from the working hours (without pay deduction) the time for, and bear the cost of, the educational work—looking for their reward in a higher working efficiency, and its maintenance. It is also satisfactory to see this matter advanced to the stage at which intelligently devised schemes are in actual operation. But it is only through the co-operation of the manufacturers large and small that such schemes can be made general. Will the manufacturers universally fall into line? There's the rub. The President of the Institution of Gas Engineers (Mr. A. E. Broadberry) doubts it, without the application of compulsion. If the schemes are not general, then the indifferent manufacturer who does not want the trouble of apprentices and educational schemes interfering with the even course of his work will simply recruit his young men, by tempting terms, from firms who have done what he has neglected to do. This is something that must be countered. But the fact that the attempt will be made must not be allowed to stand in the way of doing what is essential, nor to stop the growth, even though it be slow and for a time scattered, of the suppression of defective training by establishing a sound system—a system which affords opportunities to brains generally, and does not give preferential treatment to birth, money, or influence. Upon brains the industrial efficiency and progress of the country largely depend.

But, after all said and done, there is still another factor to be taken into account, and that is the trade unions. The trade unions can have no legitimate objection (we have not heard of any) to the improvement of the workers educationally, unless they see that an improved intellect among their following might affect their own methods and objects. We can conceive it to be quite possible that, if these methods and objects are not revised, the higher education of the craftsman might act distructively upon them; for the better educated man is not going to be everlastingly cajoled by certain of the doctrines that emanate from the controllers of the unions. We see in the educational schemes for raising the efficiency of craftsmen nothing that need be in any way antagonistic to the legitimate protective work of trade

unionism; for there is no reason why the skilled workmen's unions should not themselves take an active part in co-operating to ensure the higher education of workmen; nor do we know of any reason why, if the workmen are intellectually improved by their technical training, their unions should not also be improved. There is one thing, however, of which the trade unions cannot rob man or master, and that is the knowledge gained through the technical training of the former, and which knowledge must—perhaps unconsciously—make its imprint upon the work. Bearing upon this, a significant remark by Mr. D. Milne Watson during the discussion upon Mr. Bennie Gray's paper was that the fitters of his Company liked the apprentices who had been technically trained in workshop and school better than those who went to them in a raw state. This appreciation by the old hands of the higher efficiency of the lads is distinctly encouraging.

Mr. Bennie Gray submits the point that this better training, and the resulting higher efficiency, are a means of getting more work done in a fewer number of hours per week, and so permitting more leisure on the part of the workmen. Thus one of the objects of trade unionism would be served, though in opposition to another object which seeks the curtailment of the output per man for an economically unsound reason. But times are changing; and the pet theories of the trade unions must go into the melting-pot, and come out with the higher aim, while still defensive, of assisting, through their influence among the men, in the advance of the national interests, which will conduce to those of the men themselves. But will reform extend to the leaders of the unions? Whether it does or not, the more enlightened schemes for producing higher man efficiency in the industry must go forward.

Trading Profits and the Rates.

The Manchester Corporation Gas Committee, after further consideration of the matter, are still of the opinion, recorded two or three weeks ago, that in the forthcoming financial year it will not be possible for them to contribute anything in relief of the rates. In fact, even without allowing for a contribution, and with the present price of gas, a big deficit is anticipated, after making full provision for renewals and sinking fund. Therefore the Committee feel that they have no alternative but to raise the charge 6d. per 1000 c.ft. In addition to this passing of the usual contribution to the rates suggested by the Gas Committee, both the Tramways and Electricity Committees propose to reduce their contributions to practically one-half. These two reductions, and the total stoppage of the Gas Committee's quota, represent approximately 6d. in the pound on the rates. Should the City Council agree to the various suggestions here outlined, the citizens and the gas consumers will have the satisfaction of reflecting that something is being done towards placing the different burdens upon the shoulders which should rightly bear them.

Coal Price Admissions.

It is clear that there are colliery people who do not appreciate the activity of the Coal Controller (Mr. Guy Calthrop) in investigating the question of pit and retail prices for coal; and they have even less kindly feeling for the work to which he has put his hand than they had for the Price of Coal (Limitation) Act, which the Coal Controller finds a more useful instrument than did the Board of Trade under the old *régime*, though the quarter in which the measure was actually begotten. Coal owners saw the direction of the Coal Controller's gaze when he reduced the retail price of coal in London by 1s. per ton (we in London know the reduction was accepted without a public murmur), and issued his warning that collieries and merchants must keep strictly within the terms of the Act unless they wanted to be visited with the pains and penalties of their misdoings. Now the Controller has invited the local authorities throughout the country to assist in compiling information regarding the district prices of coal, sources from which the coal is obtained, and railway rates, which shows an intention to put things on a firm base so far as the Act is concerned. A new song is being sung since the movement began. The day was when, despite the evidence of profit distributions among shareholders, there was a lugubrious refrain regarding the rise of pit costs, the smallness of the standard excess of 4s. per ton, and the leanness of things generally for the colliery proprietors. To-day the "Iron and Coal Trades Review" is confessing that "not all collieries have rigidly adhered both to the letter and spirit of the Act, and a number of concerns have interpreted it to their own advantage, and the prices that are being obtained in many cases are higher than intended under the Act." It is admitted that in a large number of concerns the 4s. leaves a good margin to meet the increased cost of stores, wages, &c., but that there are some concerns in South Wales that are losing money. South Wales colliery dividends have been making the mouths water of stockholders in sliding-scale gas companies, the greatest factor in the reduction of whose dividends has been the cost of coal delivered. However, the present admissions strike callously upon the former doleful arguments, which we know from the facts within our knowledge had not about them any depth of sincerity.

PERSONAL.

Mr. W. B. Reidie, J.P., the Engineer-in-Charge of the Stratford Station of the Gas Light and Coke Company, has been for the sixth time unanimously elected Chairman of the Barking Urban District Council.

As successor to Mr. S. E. Halliwell as Secretary and Manager to the Littleborough Gas Company, there has been selected Mr. Arthur Halliwell (for the past thirteen years Gas Engineer and Manager to the Lytham Urban District Council). Mr. A. Halliwell—who, it may be remarked, is no relation of Mr. S. E. Halliwell—was trained at the Brighouse Corporation Gas-Works, and was afterwards Manager of the Marsden Gas-Works.

It will be remembered that at the Southern District Association meeting in March, Mr. W. E. Price (the Hon. Secretary of the Institution of Gas Engineers) announced that Mr. F. L. Halford, of the Explosives Supplies Department of the Ministry of Munitions, was suffering from a somewhat severe illness, and that Mr. W. Doig Gibb had taken up the additional work during Mr. Halford's enforced absence. It will be with considerable satisfaction that those many gas men who have become acquainted with Mr. Halford will learn that last week saw his return to his departmental duties, and that his old customary energy was again soon in evidence.

OBITUARY.

SAMUEL CHANDLER.

Readers will be sorry to learn of the death, at the age of 72, of Mr. Samuel Chandler, whose name has for many years been a household word in the gas industry. He passed away last Wednesday, after a long and painful illness, at his residence in Balham. Of the inventions which made him so well known, there is little need to say anything; but in "King's Treatise on Coal Gas" (published in 1878) a self-acting removable dip-pipe invented by Messrs. Chandler and Stevenson is described and illustrated. Mr. Chandler was then principal of Messrs. S. Chandler and Sons, of Kennington, whose work was largely in connection with main-laying operations. In 1879, however, he became one of the founders of Messrs. Kirkham, Hulett, and Chandler, Ltd., being one of the inventors of the original patent "Standard" washer-scrubber. From this business he retired just over 24 years ago. Some time he spent in Wales, with the Pontybodkin Coal Company.

The deceased leaves a widow, three daughters, and four sons, with whom sympathy will be felt in their loss. Of the sons, Mr. S. B. Chandler is the Chief of the Sales Department of the South Suburban Gas Company, and the President of the London and Southern District Junior Gas Association; Mr. E. V. Chandler is a Second-Lieutenant in the Royal Field Artillery; Mr. A. B. Chandler is with the army at Salonica; and Mr. W. J. Chandler has returned injured from the Western Front.

Mr. W. Wyver, Engineer and Manager to the Whitstable Gas Company and Whitstable Water Company, has died, at the age of 53, after an illness extending over four months. Mr. Wyver had been with the Companies for upwards of 33 years; and during this time many alterations and additions were carried out by him. He was a member of the Southern District Association of Gas Engineers and Managers. His son and assistant, Mr. H. Wyver, has been appointed to succeed him.

Though most of his work was in connection with bridge building, the name of Mr. A. S. Biggart, whose death took place on Thursday last, was by no means unknown in the gas industry. He was trained as a mechanical engineer, and for many years was closely associated with the late Sir William Arrol. In connection with the late Mr. William Foulis (when Gas Engineer to the Glasgow Corporation), he took up the study of hydraulic stoking plant; and machines were designed which were installed in a number of gas-works both in this country and abroad. As a matter of fact, the only paper which Mr. Biggart read before the Institution of Mechanical Engineers was in 1895, on the subject of "Hydraulic Stoking Machinery and Labour-Saving Devices in Modern Gas-Works."

NEW SCHEDULE OF PROTECTED OCCUPATIONS.

GAS undertakings throughout the country have received a circular, and have by this time made returns, relative to the new Schedule of Protected Occupations. The circular was sent from the Ministry of Munitions, No. 6, Whitehall Gardens, S.W. 1, and is dated April 21, 1917. In connection with it, we particularly draw attention to an announcement made in our editorial columns as to the use in the schedule of the term "certified." [Since the following information was circulated, it has been officially announced that the new scheme for regulating the release of munition workers for the Army will take effect next Monday, May 7.]

POINTS FROM THE CIRCULAR.

In the circular (which is signed by Sir Stephenson Kent), it is mentioned that the War Cabinet have decided that, in order to provide the armies in the field with the men they require, it is necessary to release from firms engaged upon war work a considerable number of men fit for general service (Category "A"). The War Cabinet have, therefore, decided to replace the various methods of protection under which men of military age are being retained on this work, by a new system designed to protect the minimum number of men essential to output, and remove certain inequalities and anomalies created by the present systems.

The new system is based upon a Schedule of Protected Occupations, in certain of which an age qualification is introduced. The schedule comes into force to-day (May 1), and supersedes as from this date all war service badges and badge certificates, the trade cards issued under Army Council Instruction 2361, and the list of protected firms (known as the White List, or the M.M. 94 list) issued under Army Council Instruction 2348.

NEW RECRUITING AUTHORITY.

Machinery is being established to regulate the withdrawal and the protection, in accordance with the schedule, of men employed in firms engaged upon Admiralty, War Office, or Munitions work. An office, to be known as the Munitions Area Recruiting Office, has been opened by the Army Council in each recruiting area. Each of these offices will contain, in addition to the recruiting staff, at least one representative of the Ministry of Munitions, who will be known as the Munitions Area Dilution Officer. The War Office intend, as soon as the information is available, to centralize in the Munitions Area Recruiting Office all necessary records concerning the men employed in the different works in the area, in order that no man may be called up by any other recruiting office or without consultation with the Munitions Area Dilution Officer. All inquiries concerning the application of the Schedule of Protected Occupations should be addressed directly to the Munitions Area Dilution Officer of the area where the works are situated.

On the special form provided, a return was required by to-day of all male employees who on Jan. 1 last were over the age of 16, and are in the employ of the works on the date of making the return. Also required are the totals of women and boys employed on that date. The Minister of Munitions recognizes that the compilation of this return throws considerable labour upon depleted staffs. Unless, however, the return has already been made, it will not be possible to protect a firm or works from the annoyance caused by the indiscriminate issue of calling-up notices, since the information in the hands of the Military Authorities is based upon the place of registration rather than upon the present place of employment. Firms employing more that 2000 men who were unable to render the return complete by to-day were asked to forward an instalment by that date, so that the issue of certificates of protection may be quickly begun. Warning is also given as to the results of making false or misleading statements.

PROTECTION CERTIFICATES.

A card to serve as a protection from recruitment for military service, to be known as a Scheduled Occupation Certificate (Army Form 3476A), will be issued by the Munitions Area Recruiting Office to every man entitled to protection under the Schedule of Protected Occupations. A card (Army Form W. 3476) to serve as a temporary protection, will likewise be sent to men of military age who are not in an occupation covered by the schedule, but whom it is not proposed to call up for the present. Each man should always carry with him the card with which he is provided, as a protection against police inquiry.

With a view to reducing the office work to be laid upon firms under the new scheme, it has been determined not to require the return of war service badges and badge certificates upon cancellation. A poster announcing the final cancellation of the exemption conferred by the war service badges and badges certificates granted by the Admiralty, the War Office, or the Ministry of Munitions will be sent out in the course of this month.

SUBSTITUTION.

It is advised that the schedule should be carefully studied, with a view to ascertaining which classes of men are to be released. Efforts will be made to supply substitutes wherever necessary for men who are called upon to join the Colours. Any case of dispute as to the efficiency of the substitute provided will be decided by the representative of the Admiralty or of the Ministry of Munitions, as the case may be. It must, however, be understood that the need of the Army for men is too urgent to admit of the release of men being delayed in every case until substitutes have been provided, and that the supply of male substitutes is likely to prove unequal to the demand. It is, therefore, incumbent upon everyone to make every effort to fill the gaps, both by employment of women on all work which they are able or can be trained to perform, and by the transfer or re-arrangement of labour within the works. If it is considered that a substitute will be needed for any man not protected by the Schedule of Protected Occupations, a claim should be put forward to that effect. The Munitions Area Dilution Officer, or the Admiralty representative, will determine whether the claim can be allowed; and, if allowed, he will notify first the Area Employment Officer. If, within a limited time, a substitute is not provided by the Employment Exchange, the Area Substitution Officer of the National Service Department will be notified.

COURSE TO PURSUE IF PROTECTED MEN ARE CALLED UP.

If a man engaged upon Admiralty, War Office, or Munitions work, in an industry dealt with in the schedule, receives a notice calling upon him to join the Colours which does not bear upon it the stamp of the Munitions Area Recruiting Office for the area in which the works are situated, the notice should be returned immediately to the recruiting officer who issued it, with a statement to the effect that the man who has received the notice is employed by the firm on Admiralty, War Office, or Munitions work.

IMPORTANT LIMITATION IN REGARD TO AGE AND MEDICAL CATEGORY.

As is stated in the preface to the schedule, it is not intended for the present to call up any man engaged upon Admiralty, War Office, or Munitions work in an industry that is dealt with in the schedule, who has attained the age of 32 by Jan. 1 last, or any man who has not been passed fit for general service (Category "A"), subject to the provisos in paragraphs 6 and 7 of the notes to the schedule.

EXCEPTIONAL CASES.

It is open to employers to make claims for the protection of the men who are in an occupation scheduled as protected. If a case arises where an individual is called up, who is not protected under the schedule, but whose pivotal position or exceptional qualifications render him irreplaceable, a claim may be made for his retention. It must, however, be recognized that such claims can only be considered in cases presenting unusual features.

Facilities should be given to the men to consult the Schedule of Protected Occupations; and for this purpose copies should be kept in places accessible for reference at the works. Any man engaged upon Admiralty, War Office, or Munitions work in an industry dealt with in the scheduie, who receives a notice calling upon him to join the Colours before May 15, and any man so engaged who has not received a card of protection by that date, may, if he considers he is engaged in a protected occupation, make an application on his own behalf, or through the medium of his Trade Union, to the Enlistment Complaints Sub-Committee of the area (addressed to the care of the Munitions Area Dilution Officer) for protection under the Schedule of Protected Occupations.

Under the instructions issued to Munitions Area Recruiting Officers a period of fourteen days before the man is required to report for service will be given.

THE SCHEDULE.

INFORMATION FROM THE PREFACE.

In a preface to the schedule, much of the information given in the circular is found. The causes which necessitate the revision of the position of badged men in industries engaged on war work are set out. Then the decision is mentioned that war service badge certificates and trade cards will be superseded by a system which protects from recruiting only men who may from time to time be found indispensable for the fulfilment of the varying programmes of ship construction, munitions, and other essential Government work. For this purpose the present schedule of protected occupations has been prepared, and is provisional. It may be modified later if the Army's need is again so urgent that a further release of men from the manufacture of munitions is found necessary, or if experience shows that operations now performed by men protected under the schedule can be undertaken by men not required for the Army, or by women. It will therefore be understood that the schedule does not confer any right of exemption from military service, and that the only ground for retaining a man of military age in one of the scheduled occupations is that he is engaged on Admiralty, War Office, or Munitions work, or in railway workshops. The national need at the present moment does not permit of the retention on such work of any man of military age who does not devote his whole time and energies to it. As far as is found possible, the men made available for recruitment under the new scheme will be released in age groups, commencing with the younger men to be released. And, in order to minimize as far as may be the diminution of output and dislocation of industry, reasonable intervals will be allowed between successive releases of men. Men engaged on Admiralty, War Office, or Munitions work in industries dealt with in the schedule who are not protected by it will only be posted for service after consultation with the local representative of the Government Department concerned. The Government propose to invite the assistance of representatives of labour in deciding the case in which the status of a man under the schedule is doubtful. For this purpose, the Enlistment Complaints Committees which have been set up throughout the country will be utilized; and the present representation of labour on the Committees will be increased.

NOTES ON THE SCHEDULE.

In the notes attached to the schedule, it is stated, among other information, that (1) the schedule supersedes all badges and badge certifi-

cates, trade cards, the machinery set up by the Army Council Instructions No. 2348 of 1916 (the "White List") and No. 2406 of 1916 in so far as exemption or protection from recruiting is concerned. (2) The cancellation of badge certificates and trade cards and the withdrawal of the White List do not imply that all the men who were by these means exempted or protected will be recruited. (3) The protection given by the schedule applies only to men engaged on Admiralty, War Office, or Munitions work, or in railway workshops. If a dispute arises as to whether a man is engaged on such work, it will be decided in the last resort by the Government Department concerned. . . . (5) Men engaged on the work mentioned in the industries dealt with in the schedule who are not passed fit for general service (Category "A") will not for the present be recruited unless they fail to comply with the conditions set out in (6), or unless it is decided that the Army require the release from such work of men in a lower medical category. (6) The only ground for including an occupation in the schedule is that the men in that occupation are engaged on Admiralty, War Office, or Munitions works, or in railway workshops. Any men found to have a bad record for absence from work will therefore obtain no protection by reason of being employed in an occupation covered by the schedule. (7) The schedule does not confer any right of exemption from military services. For instance, if skilled artificers needed by the Army cannot be supplied from other sources, men engaged in any occupation protected under the schedule may, by arrangement with the Admiralty, War Office, Ministry of Munitions, or Board of Trade, be called up for service in artificer units. Wherever, too, it is found possible to provide substitutes, either generally or in a particular instance for men employed in occupations covered by the schedule, the protection afforded by the schedule will not be continued. (8) The protection set out in Section F (Engineering, &c.) is not limited to men employed in engineering shops, but applies also to men employed on Admiralty, War Office, or Munitions work elsewhere—*e.g.*, a smith or fitter employed in an explosive factory is protected. . . . (10) The new procedure now set up does not preclude an application to the Local Tribunal under the regulations and instructions for the time being in force; nor does the schedule purport to deal with all the industries in which the Government Departments are interested. As stated in the circular, for the present (subject to Notes 6 and 7) it is not intended to enlist from the Admiralty, War Office, or Munitions work in the industries dealt with in the schedule, men who have attained the age of 32 by Jan. 1 last. As already stated, the schedule (which is subject to revision from time to time) comes into operation to-day.

Some Protected Occupations.

The schedule follows. From some 25 pages giving lists of protected occupations, we take the following without going into details, except in respect of gas undertakings:

B. Mining and Quarrying.—Fire-clay mining.

C. Furnace Firebrick.—Furnace firebrick, including ganister, magnesite, fireclay, chrome, and silica brick manufacture.

D. Coke-Oven Plant.—Coke-oven plant (bye-product plant workers are dealt with under chemicals and explosives).

E. Metal Manufacture.—All classes of workers, except where otherwise specified, such as unskilled men.

F. Engineering connected with the making, erection, repair, and maintenance of plant and machinery. The men here indicated are not only those employed in engineering shops, but apply to men engaged elsewhere on Admiralty, War Office, and Munitions engineering work.

H. Miscellaneous Metal Trades.—Under this, tube and tube fittings manufacture (iron, steel, copper, aluminium, and alloys) is mentioned.

K. Chemicals, Drugs, Explosives, Oils, Rubber, &c.—Chemicals and explosives manufacture, including manufacture of smoke-producing material, coal tar products, chemicals (solid, liquid, and gaseous), and fertilizers (sulphate of ammonia, &c.).

P. Light and Power Undertakings.

Gas Undertakings.

[In cases where the undertakings are "certified" by the Ministry of Munitions under the Munitions of War Act—See Editorial Article on p. 177.]

Code No.		Ages Below which Men may be Called Up.
1931	Foreman	23
1932	Assistant Foreman (except in coal and coke department, flue cleaners, and yard)	23
1933	Grab Crane Drivers	23
1934	Chief Valveman or Governor House Man	23
	Carbonizing Department (Coal Gas).	
1941	Charging-Machine Driver; Repairer	23
1942	Gas Stoker	25
	Carbonizing Department (C.W.G.).	
1951	Gas Makers	23
	Outdoor Departments.	
1961	Gas-Fitter or Plumber	28
1962	Main Layers, Jointers, or Service Layers (skilled)	25
	Workmen engaged on Coal Tar Products come under Section K and include—	
1121	Foremen or Leading Hands	23
1126	Electric Furnacemen	23
1127	Process Charge Hands	23
1128	Other Process Workers (excluding unskilled men)	25
1129	Fillers of Chemical and Gas Projectiles and Cylinders	23
11210	Gas Cylinder Testers and Valve Fitters	23
11212	Still and Retort Firemen	25
	Other Workmen employed by certified gas undertakings as and if specified in this schedule under the heading of Engineering, &c. (Section F), including— Riveters, Platers, Fitters, Erectors, Toolmakers, Skilled Mechanics engaged on the repair or maintenance of motor or steam lorries, Turners, Metal Machinists, Electricians, Foundry Workers, Smiths, Forge Workers, Draughtsmen (not Tracers), Sheet Metal workers.	
	General—	
1541	Carters, Lorrymen, and Draymen (Horse or Power	27
0617	Coppersmiths	24
1055	Joiners employed on Maintenance of Works Plant	25
1601	Steam Engine Drivers (stationary engine or works locomotive)	25
1602	Shunter (in works)	28
1063	Retort and Furnace Builders (must obtain protection for each specified job)	23
	R. Professional Occupations and Administrative Staff.	
	Professional Occupations.	
2001	Chemist (Works, Analytical, or Research)	19
2002	Mechanical Engineer	23
2003	Electrical Engineer	23
	Administrative and Technical Staff employed by Firms engaged in the Industries dealt with in the Schedule.	
2011	Working Principal of a Firm	25
2012	Managing Director	25
2013	Works Manager	25
2014	Assistant Works Manager	25
2015	Head of Administrative Department	25
2016	Incorporated or Chartered Accountant	25
2017	Technical Staff and Clerks possessing high technical knowledge—*e.g.* estimating and cost clerk, rate fixer (The last category should cover all outdoor superintendents, inspectors, and others possessing technical knowledge and experience).	25

Explanation by the National Gas Council.

In the course of an explanation issued by the National Gas Council, the following information appears:

The new "Schedule of Protected Occupations (M.M. 130)," which comes into effect on the 1st of May and makes all badges obsolete and ineffective, strictly interpreted, only relates to gas undertakings which are "certified" by the Ministry of Munitions under the Munitions of War Act. The National Gas Council are, however, informed that in all cases of undertakings which although not "certified" have had badges granted to their employees or can claim to be engaged on work for the Admiralty, War Office, or Ministry of Munitions, the "Return of Employees (M.M. 82s)" asked for in Sir Stephenson Kent's circular letter of the 21st April (M.M. 128) should be filled up and sent to the Dilution Officer of the Munition Area in which the works are situated, who will deal with the undertaking at his discretion. The employees in undertakings so recognized by the Ministry Dilution Officer would, as a consequence, be placed outside the jurisdiction of the Local Recruiting Officers and Tribunals.

All other gas undertakings will, unless any further protection be subsequently afforded them, have to rely upon the recognition of their necessity to the community by Local or Appeal Tribunals for the exemption of any absolutely essential men. In this connection, the fact that the gas industry is scheduled as an essential industry by the Director of National Service is of importance and value; and the limits of protection afforded to "certified" undertakings by the schedule (which is very closely in agreement with proposals submitted to the Reserved Occupations Committee by the Council) should be helpful in advocating claims for further exemptions of vitally important men.

Tribunal exemptions already granted or applications or appeals pending in respect of men in gas undertakings that are not "certified," or do not come within the wider category above indicated, do not appear to be in any way affected by the issue of this "Schedule of Protected Occupations," which only deals with firms "engaged on Admiralty, War Office, or Munitions work or in railway workshops."

Society of Chemical Industry.—The annual general meeting of the London Section of the Society will be held next Monday evening at the Birkbeck Café. In addition to the election of officers and Committee for next session, there will be a brief report by the Chairman (Mr. A. R. Ling) on the work of the past session. After the formal business has been taken, the meeting will resolve itself into an informal one.

National Insurance (Unemployment).—The Umpire decides that contributions are payable under the National Insurance (Part II.) (Munition Workers) Act, 1916, in respect of workmen engaged in the manufacture of gas-testing apparatus, or those employed in the repair of coke-oven bye-products plant. Contributions are not payable in respect of workmen employed in the repair of coke-oven plant (other than buildings, machinery, or bye-products plant), or of those employed by gas companies, and engaged in the repair of gas-retorts and retort-settings.

ELECTRICITY SUPPLY MEMORANDA.

THE "Electrical Review" has taken up the drum-sticks on behalf of the disappointed Hackney Borough Council, whose Electricity Department is anxious to fight the big Gas Light and Coke Company over the question of preferential charges, but wants other people to help them pay the expenses involved. Circular letters have been flying around to municipal concerns, trying to encourage them to indulge in something that is known to the law as "maintenance." Those Committees who will not have anything to do with the matter, or who have only subscribed sufficient to make the Hackney nose turn up, have received appealing letters to reconsider their decision. The Local Government Board have stated that they cannot give their consent to subscriptions for this purpose. They have no power to do so; and any subscriptions will have to be dealt with by the District Auditor. Now the "Electrical Review," despite this, has given the hospitality of its columns to an article which does three things it ought not to do, and there is no health in any one part of it. In the first place, its intention is to incite municipal authorities to contribute money to the support of litigation by another municipal body; in the second place, it speaks in its opening and closing lines of "Gas Association," and so appears to implicate the British Commercial Gas Association, which, if intended, would be a slander; and, thirdly, it counsels the readers of the "Review" to hoodwink the Local Government Board by muddling-away their subscriptions to quarters where they have no legitimate right. The Board will, with interest, note these words; "Other Committees have asked the Local Government Board, and have made the reply an excuse for doing nothing, as if they could not have voted it to their engineer as salary, and arranged for him to send it in his own name."

Preferential Charges and Help for Hackney.

The article was communicated to our contemporary; and it is wrong of our old sedate friend—which always tries to keep in the path of virtue, and from time to time reshackles its editorial feet with such heavy metals as lead and copper which prevent it going far astray—to give space to a "communicated" article of the kind. Perhaps pity for Hackney induced it to step aside for once from the straight path by publishing a communication counselling wrong-doing. According to the heading of the article, the point at issue between the Gas Light and Coke Company is "lighting energy at power rates." There is no attempt to discuss the issues in the ight of Long Eaton, Ilford, and South London; but the argument suggests that commercial expediency should take precedence of legal enactment, which is the Huns' way of looking at things, and is certainly not the way that our legal masters regard the law. The article absurdly opens: "When the Gas Association [which should read the Gas Light and Coke Company] decided to go for Hackney, we electrical optimists smiled, with the great big smile of the tiger when he sees his dinner walking the right way." The smile should be reserved until one or the other side has had enough of the litigation, or until the verdict of the House of Lords has been registered. It is then suggested that all the pother is not for the benefit of Hackney, but because a verdict is wanted which will prevent factories from obtaining lighting energy at power rates. That is the whole point. And in regard to it we merely ask ourselves the question, why a power user should get his lighting units at a preferential rate—and such a low rate too!—over the consumer of an equal or greater number of lighting units who does not use power? The Courts will give us the answer. "If the gas men win, our factories will require two sets of cables throughout—one for power and the other for lighting. A motor set up a hundred yards from the mains will require two sets of cables, one for the motor current, and one for the lamp beside it. The silly change will require the expenditure of thousand of pounds for new wiring—money thrown away for nothing at all." This does not touch the legal question. The same thing happens when a factory is supplied with gas at differential rates for power and lighting—the two supplies have to be separately metered. The writer then admits that the confidence that was felt that the whole electricity industry would come to the side of Hackney with its purses has been rudely shaken by events. He scoffs at those who have refrained, at those who have given with parsimonious hand, and at those who have sheltered themselves behind the Local Government Board, instead of practising a bit of deception upon that estimable and law-abiding body. The foolish performance, which will do more harm than good to the desire of Hackney for money to support their action, ends with this piece of additional absurdity: "You people who are standing by, idly watching Hackney fight your fight, like so many Conscientious Objectors, have you ever thought that it would pay Hackney and the Gas Association to come to terms secretly, so as to promulgate a verdict which would give the gas people all they want?" The "gas people" smile. The Gas Light and Coke Company are not likely to enter into any compact, nor are they beating the big drum for money to support their attack on what they conceive to be an infraction of the law on the part of a competitor. The law in question was framed not only in the interests of fair trading, but in defence of customers, so that one should not receive preferential treatment over another, but that there should be equity all round. Above all traders, the municipal ones should protect the principle underlying the enactment, and not be agitating for money to be spent in an attempt to wreck it. The tremendous effort that has been made to get together funds for this purpose tells a tale; but the Courts will interpret the law, quite apart from these efforts and the arguments as to the cost of duplicate wiring, gas piping, and measuring instruments. Then it may be the "gas people" will smile as they watch the chagrin of the "tiger" as he sees his dinner walking the other way.

The Stupid Argument of the Article.

However, the "Electrical Review" does not hesitate to support its contributor, and what it calls his "spirited" article. It is "spirited," but not in the sense our contemporary means. It also enlightens its readers upon one or two points. The article is by a central station engineer, not in the London area. Immediately after this readers are reminded that, at the annual conference of the Incorporated Municipal Electrical Association last year, Mr. H. Faraday Proctor, who is the Central Station Engineer at Bristol, recommended the Hackney case to the members; and a resolution was passed pledging the Association to support the Borough Council with evidence and money. It then tells its readers that the response to the invitation to form a "substantial guarantee fund" has been so poor that it believes "the total amount so far promised is less than £1000." Later on, it also commits the error of referring to the "Gas Association which has instituted the proceedings." It describes the support of the local authorities as a "discreditable showing." It also asserts that a very strong case can be made out for the practice complained of on "technical grounds," but is very careful to avoid saying anything as to the legal grounds. It confesses to a feeling of "disappointment and regret" that so few of the local authorities have realized the importance of the matter, which, in other words, suggests that they do not know their own business, and, if they are keeping within the terms of the law, that they have no right to decline to support others who, it is alleged, are not doing so. But "it is not too late to make amends; and we may point out that, in the highly probable event of victory for the Council, the guarantee fund will *not be largely drawn upon*." Then why agitate for more funds? Is not the "less than £1000" sufficient for the purpose if the success of the Council is "highly probable," and the guarantee fund will not then be largely drawn upon? But the smashing blow for the non-supporting local authorities comes at the end. "True economy," it is said, "is laudable; but to refrain from supporting so good a cause is not economy, but parsimony, and calls for the severest censure." And who, pray, made the "Electrical Review" a judge in such a matter, so as to entitle it to describe the cause as a "good" one, and severely censure local authorities up and down the country for holding different views?

The "Electrical Review" also Speaks.

After the outburst of disapproval at the appointment of a further Committee by the Board of Trade, there comes something in the nature of a reaction. Correspondents in our electrical contemporaries are now welcoming the new Committee, because they believe that it is going to straighten out the crooked ways in the electrical industry which mar its progress. The electrical engineers are a self-sacrificing people. For the good of the industry, many of them are hoping to see big concentrations of generating plant displace the present smaller and scattered stations. The greater the concentrations, the fewer the chief electrical engineers who will be required. Many of them will then have to take subordinate places in the generating stations, or become nothing more than district distributing and commercial managers. It is to be a great revolution for them. For instance, Mr. W. W. Lackie, the Electrical Engineer of Glasgow, is of opinion that Scotland should not need more than three large power stations in place of the existing 31 electricity supply sources. This means that only three chief electrical engineers would be required; and 28 would be unemployed so far as engineering qualifications go, unless they took the inferior positions referred to. Mr. Lackie is convinced that joint ownership and bulk supplies will be part of the national policy in connection with electricity supplies and small townships as well as rural areas. Large concentrations of the kind would bring in their train many changes for those connected officially—and even journalistically—with the electricity industry.

Electrical Altruism.

In last week's "Memoranda," reference was made to the increase of the prices of metallic filament lamps—for example, the 100-130 volt, 10-60 watt, lamps from 2s. 2d. to 2s. 6d. each. A correspondent of the "Electrical Times" points out that almost simultaneously a reduction has been made in America of the 105-125 volt, 10-50 watt, lamps from 1s. 2d. to 1s. 1½d. There is thus over 120 p.ct. difference between the existing prices in this country and America. The correspondent wants to know why this is; and he speaks of the "monopolists of the lamp ring" in this country. The cost of labour and material in America is, to put it mildly, at least as high as here. On the Continent, he believes, metallic filament lamps have been sold for years at less than half the price charged here. It is evident from American and German practice that a 60-watt metal lamp can be sold

Price of Electric Lamps.

profitably at 1s. or thereabouts. If there is no satisfactory explanation of the discrepancy of the prices, he suggests that the subject should be tackled earnestly by the Incorporated Municipal Electrical Association, the Institution of Electrical Engineers, and the Point-Fives—about the last-named of whom we have not heard lately. Perhaps they have been dissolved by a condition of things that has made almost, if not entirely, non-existent a charge of 0·5d. per unit for general purposes. Perhaps the organizations named will not be prepared to take up the question. If they are, they had better see that no electrical engineer has part in handling the matter who is a shareholder in any concern interested in the manufacture of lamps.

A House Divided Against Itself.

We are interested in a little domestic controversy just now at its height in the family of electrical engineers, because the subject around whom the controversy is running thickly and severely is Mr. C. H. Wordingham, who some time ago contributed an article to our columns advocating collaboration between the gas and electrical industries, but on terms with which, if we remember rightly, we did not altogether agree. Mr. Wordingham is the nominee for the presidency of the Institution of Electrical Engineers; and the "Electrical Times" has taken up arms against him—not through any personal dislike. He seems to be guilty of two crimes. The first is that he is Chief Electrical Engineer to the Admiralty; and the second, that he is a man who speaks his mind, and refuses to be a party to any deception in regard to current topics and problems of the electrical order. His frankness on collaboration between the two industries, and his ideas as to electricity becoming a bye-product of gas were not electrically appreciated; and he is said to have made "sport of," and "ruthlessly criticized," electric cooking and heating, electric battery vehicles, and large generating sets. We think these things are the incentives of opposition rather than the matter that is put foremost—his position in these times at the Admiralty, which it is thought would preclude him (being a Government official) from representing the Institution before a Government department. It seems to us that this might be just now rather a recommendation than otherwise, as his views might be regarded as unbiassed. But the Associated Electrical Engineers of Greater London and the "Electrical Times" do not think so. The latter asks: "Do we want a detached and impartial President for our Institution at this crisis? Or would it be preferable to have one who is heart and soul a partisan?" The "Electrician" thinks there is a great deal of exaggeration about the opposition; and "Electrical Industries" is of opinion that the campaign represents perhaps the most forlorn hope in which any electrical journal could indulge.

Toronto Gas Undertaking.

Some records and recollections of the Consumers' Gas Company of Toronto which have been prepared for the "Intercolonial Gas Journal of Canada" by Mr. W. H. Pearson, sen., show that gas was first supplied in the city in 1842; the price in the early days having been $5 per 1000 c.ft. The concern then furnishing the supply was the City of Toronto Gas Light and Water Company; but the high charge and bad quality having created general dissatisfaction, it was resolved to form a new undertaking, called the Consumers' Gas Company. In 1847, the new Company obtained an Act of Incorporation, and a Board of Directors was appointed; and in the following year the works of the old Company were purchased. Some seven years later, complete new works were erected on another site; and in 1887-88 and in 1909 this process had to be repeated—the last new works, with a daily capacity of 5 million cubic feet, having been designed by Mr. W. H. Pearson, jun., the Company's Engineer. This indicates what a busy time the Company have had in keeping pace with the growing demand. As a matter of fact, the population of the city, which in 1849 was 25,000, is now about 500,000. In 1909, the Directors, having considered it desirable to have an inspection made of the Company's whole plant, both old and new, secured the services of the late Mr. Thomas Newbigging; and his subsequent report must have proved exceedingly gratifying to the management. He concluded by saying: "The order and cleanliness of the works and the freedom from anything likely to create a nuisance are remarkable, and such as reflect credit on all concerned. In the Toronto gas undertaking, the shareholders may be congratulated upon possessing a property the value of which can hardly be exaggerated." Mr. Pearson, sen., says he is informed that 60 p.ct. of the consumption of the Company for the past year has been for purposes other than lighting. When (after 55 years' service) he retired from the management in 1909, it was about 50 p.ct. The output for the year preceding his resignation was 2226 million cubic feet, or nearly 160 times more than when he joined the staff; and the number of meters in use was 55,000. For the past year, the output was 3768 million cubic feet, and the number of meters in use upwards of 104,000.

Coke-Oven Managers' Association.—The Hon. Secretary of the Midland Section of the Coke-Oven Managers' Association (Mr. G. H. Lant) states that the meeting that was arranged to be held in Sheffield last Saturday had to be cancelled, as Mr. P. B. Nicholson, owing to unforeseen circumstances, was unable to read his paper on the "Bye-Product Coke-Oven Industry."

LUNGE ON COAL TAR.*

The fourth edition of Prof. Lunge's well-known treatise on Coal Tar and Ammonia appeared in the year 1909; and since then there has been published a new edition of the German counterpart of the work—Lunge-Köhler's "Industrie des Steinkohlenteers und Ammoniaks," which was published in 1912. Formerly the English editions of Lunge followed very closely the text of the immediately preceding German edition, with very few omissions or additions. In the fifth English edition, which is now before us, the reader is at times referred to the German work for fuller descriptions of plant; while, on the other hand, a great deal of matter which was not available in 1912 has been included—more especially in an appendix of some 30 pages of late addenda. The German work is less voluminous, and on the whole more handy for reference; but the facts that it is already four years old, and that more than half the period has been occupied with an upheaval of earlier industrial conditions and traditions, especially in the branches of technology of which Prof. Lunge treats, will impel all concerned with them to look to the new English edition for the readiest source of guidance on the development, to date, of the production and working-up of coal tar and ammonia.

When reviewing earlier editions of this treatise, we have expressed a hope that, in view of its great length and cost, the parts dealing with coal tar and ammonia would be bound apart, so that a reader specially interested only in one of these subjects could buy the appropriate volume without dipping so deeply into his pocket or loading so heavily his bookshelves as he must do if the work is procurable only *en bloc*. We greatly regret that while the publishers have seen fit to bind the edition in three volumes, of which the first two refer to coal tar and the third to ammonia, they do not offer the latter part for sale without the other two. This notwithstanding the increase in the total bulk of the work from 1178 pages in the fourth English edition to 1718 pages in the present edition. We feel convinced that they are thereby preventing the work serving as wide a field of utility as it might well do.

We have in the past also complained of the retention in successive editions of matter which had become obsolete—the revision having been made generally by addition, without excision. Without comparing the present edition page by page with the last, we are under the impression that a genuine effort has now been made to excise matter which had obviously ceased to have even a remote historical interest. We wish, however, that the process of excision had been extended, as there are still many references to processes which are admittedly inherently unworkable, and would never have been heard of but for the lure of the grant of letters patent to the undeserving equally with the deserving, which tempted so many otherwise innocuous people to become "inventors" in the course of the last century. In many instances mere excision is not the best means of bringing the treatise, with additions of new matter, up to date—the paragraphs need writing *de novo* so as to lift them from the era of a past to that of the present generation. For example, in discussing generally the removal of benzene and other aromatic hydrocarbons from coal gas by liquid absorbents, Prof. Lunge proceeds to say that the gas, after treatment, is a "poor gas," unfit for illuminating purposes, unless re-carburetted, or "applied (as it had been already previously done with water gas) on the principle of the 'incandescent' light—namely, by introducing some solid body, as platinum, magnesia, zirconium, &c., into the flame in order to give out light after having been raised to a white heat." Surely the author could have spared a stroke of the pen to delete this antiquated and inexact paraphrase (as quoted) in favour of the words "used with the incandescent mantle," or the like?

We hope that the distinguished Zurich Professor may even now see his way, with or without an English collaborator, to go through his work and really revise it for a new and more compact edition, by re-writing all such passages as that to which we have just referred. The thought that four or five years hence the later edition of his treatise, which may then be expected, may be expanded to perhaps four volumes by the addition of another four or five hundred pages is appalling to the technical man who wishes to have at his elbow at the most two compact, yet comprehensive and up-to-date, reference volumes on coal-tar and ammonia. Notes might well be given of subject matter of paragraphs in earlier editions which have been excised or greatly abbreviated in view of their having lost, through efflux of time, the significance which they had, or promised to have, at the time they were penned. The older editions would be at hand in many reference libraries for consultation in the relatively few cases in which one of the notes in the current edition happened to arouse further interest in a particular reader. The upshot of such a radical revision of Lunge's treatise would be a work far exceeding in convenience and utility the present grandiose volumes.

We have referred at length to the unwieldiness which is, in our opinion, the great fault of this edition of "Coal Tar and Ammonia," because we believe that some effort has been made to meet

* "Coal Tar and Ammonia." By George Lunge, Ph.D., Professor Emeritus of Technical Chemistry in the Federal Technical University, Zurich; Honorary and Foreign Member of the Chemical Society, London, and of the American Chemical Society; Dr. Ing (h.c.), of Karlsruhe, &c., &c. Fifth and enlarged edition. In three parts. London: Gurney and Jackson, 1916. [Price £3 3s. net].

former criticisms in the same sense by ourselves and other reviewers. Having regard to the large quantity of valuable fresh matter which has been brought into this new edition, we think the fault of which we most complain is far less pronounced than in the previous edition. But it persists in a very large measure, and the real merits of the additions are obscured by the mass of obsolete material which has not been pruned away.

(To be continued.)

INDUSTRIAL EFFICIENCY AND FATIGUE.

THE Committee appointed by the Minister of Munitions (the Right Hon. Christopher Addison, M.D., M.P.) to consider and advise on questions of industrial fatigue, hours of labour, and other matters affecting the personal health and physical efficiency of workers in munition factories and workshops, have now presented an interim report. In view of the immediate urgency of many of the problems which they were called upon to investigate, memoranda on various special branches of the subject referred to them have from time to time been prepared by the Committee (whose Chairman is Sir Geo. Newman, M.D.); and a few of these have been noticed in the "JOURNAL" on their issue. The present report contains the results of some of the investigations which have been made on behalf of the Committee into certain problems affecting output, lost time, sickness, and other matters, which it is very generally recognized are of practical importance at the present juncture.

Attention has already been drawn by the Committee to the importance of accurate measurement of the factors just mentioned, in any endeavour to ascertain the existence of fatigue; and in the course of their inquiries, they have taken evidence from employers, workers, and other persons. These witnesses, however, have, it seems, with hardly an exception, been unable to point to any exact data in support or in disproof of their particular views. That such data should not be forthcoming in regard to the exceptional conditions at present obtaining is, the Committee say, perhaps hardly a cause of surprise; but "it is a matter of remark that there should in the past have been such a complete absence of all systematic effort on the part either of official bodies or of individual firms to collect exact data which might prove of permanent value in the solution of industrial problems. With a few exceptions, leaders of industry have made no systematic endeavour to discover by any method other than that of preconceived opinion, what is the best length for the working day, what is the most economical arrangement for spells of work, what are the real causes of lost time, and what are the health requirements which are essential to a proper industrial organization. The firms who have made successful pioneer experiments, have had few imitators." Therefore, in order to secure the data required, the Committee had to call to their assistance a number of special investigators. The inquiry is still in progress; but the information so far collected appeared to be of sufficient importance to merit publication. Hence the issue of the present volume, which, although it has on grounds of economy been kept within narrow limits, nevertheless occupies 120 foolscap pages.

The report is divided into two parts. The first—"Industrial and Statistical Studies"—deals with industrial fatigue and its causes, output in relation to hours of work, the comparative efficiencies of day work and night work, the causes and conditions of lost time, and incentives to work (with special reference to wages). The second part consists of "Medical Studies"—*i.e.*, a report on the health and physical condition of male munition workers, and an inquiry into the health of women engaged in munition factories. Among other things, reasons are suggested for the opinion of the investigator of this subject (Professor Loveday) that the employment of workers before breakfast is uneconomical and unprofitable. On the point of wages as an incentive to work, it is remarked that the evidence collected leaves no doubt that a wage system the operation of which cannot be easily understood by the wage-earners, or if understood appears to them inequitable, fails to serve as an incentive. The Committee are satisfied that a system which renders it possible for the wage-earners to obtain too easily the money they require for the maintenance of their normal standard of comfort, fails to provide an adequate incentive; while hours of labour which give little chance of spending the wages earned, diminish the incentive to earn more money. The evidence, they add, fully endorses the views already expressed by them as to the necessity for a constant study of the wage sheets. The opinion is expressed that, under conditions of repetition work—especially if it be monotonous—piece rates may be expected to give a greater output than time-wages. Also workers—particularly those newly introduced to industrial life—require protection against their own eagerness. Some of the different wage systems are fully explained. The need of proper provision for the health and comfort of the workers is emphasized in the second part of the report.

Gas Calorimetry.—The text of the detailed instructions for the measurement of calorific power adopted by the Paris municipal testing-stations [translated in full in our issue of Jan. 30] has been published as a separate brochure by the "Journal des Usines à Gaz," price 1·50 frs.

ECONOMY OF COKE GASIFICATION.

EXPERIENCES WITH GAS OF FOUR HUNDRED B.Th.U.

By JAMES E. ENRIGHT, of Tralee.

THERE has been considerable interest in the editorial articles and correspondence that have recently appeared in the "JOURNAL" dealing primarily with coal economy in gas production, and secondly, with the utilization of coke for making a combustible diluent instead of stretching the gas make from coal by drawing into it large percentages of adulterating incombustibles.

In one of the editorial articles—the one on "Manufacturing Economy and Coke Gasification" on April 3—reference was made to my Presidential Address last year to the Irish Association of Gas Managers, in which I included results obtained from the carburetted hydrogen plant installed at Tralee. In view of the current attention that is being devoted to the gasification of coke with the view of bringing about coal economy, cheapening gas, disposing profitably in normal times of coke, and finding in it at the present time a good friend, perhaps some information as to my subsequent experience of the working of the plant and the results obtained during a more lengthened period than that referred to in the address, may be of interest and at any rate of some little value to your readers.

The plant has now been in operation for a period of ten months, with the following results:

Carburetted hydrogen gas made	15,225,100 c.ft.
Coke used, including boiler fuel and stand-by fuel	363 t. 9 c.
Tar used in plant	10,197 gallons.
Wages	£128 12s. 6d.

Working out at an average cost of 9d. per 1000 c.ft. into the holder. During the same period the quantity of coal gas made was 14,885,900 c.ft., and the coal carbonized was 1357 tons. The average cost of coal per ton was 55s. I do not think these figures need much further explanation. In plain words, 363 tons of coke made more gas than 1357 tons of coal. Surely as regards fuel economy the figures speak for themselves.

In my address to the Irish Association, I stated with reference to the results then submitted: "I am fully confident that with good, clean, hard coke, these results can be considerably improved upon. I am at present using very inferior coal of any description that can be obtained, with the resultant bad, soft, dirty coke." I am still of that opinion. The condition of affairs prevailing at present is even worse than it was last year. In proof, I need only say that for the year ending March 31, out of 1800 tons of coal purchased, only 650 tons of gas coal could be procured. I wonder how many gas managers would care to be purchasing the screenings of house coal at 52s. per ton, as I am at present reluctantly compelled to do, so that I may have coke of some description to gasify in the carburetted hydrogen plant.

The working of the plant throughout has been most satisfactory; and quite apart from the financial point of view, the worry and anxiety that it has saved would alone have been worth the capital outlay. There are other important economies effected, such as in the renewal, repair, and maintenance of retorts, the abnormal wear and tear on the whole carbonizing plant in keeping up excessive heats, the number of stokers required, and the many other expenses incidental to the retort-house. I need not go into the details of the operation of the plant, further than to say that it is so simple that one man can work it, and, when the holders are full, he closes it down, and is then finished until the next morning. Often he completes his work as early as two o'clock in the afternoon.

With regard to the distribution and consumption of the mixed gas, it has been found that the burner adjustment for a 50 p.ct. gas will suit for any mixture up to all carburetted hydrogen gas. On two different occasions last winter, for periods of six days and four days respectively, when the town was flooded, and the gas-works were under water to such an extent that the furnaces were quenched—the water in the retort-house completely covering the bottom retorts—carburetted hydrogen gas was sent out exclusively, and the town was solely depending on the carburetted hydrogen plant for its supply of gas. During this period, an extra quantity of tar was employed, together with some coal in the generator. This was used with a view to increasing the hydrogen and methane in the gas and reducing the carbonic oxide (this can be kept well below 18 p.ct.). By these means, we were able to make a gas averaging upwards of 400 B.Th.U.

The daily output of gas prior to the floods averaged 160,000 c.ft. per day; and the capacity of the plant, being only 100,000 c.ft. per 24 hours, it was naturally found necessary to considerably reduce the initial pressure at the works, to tide-over the trying times. Some complaints were received from lighting consumers, mostly situated at the extremities of the mains; but in every case the difficulty was found to be due to insufficient pressure, with one exception where the incandescent burners in use are of an obsolete type, and not fitted with gas or air regulators. But no trouble was experienced with gas-engines, over forty of which are at work in the town. The mixed gas varies between 475 and 500 B.Th.U.; but a variation of anything been 400 and 500 B.Th.U. causes no trouble or complaint whatever once the burners or stoves are adjusted for the mixed gas.

From my experience of the plant, I would have no hesitation

in sending out straight carburetted hydrogen gas of 400 B.Th.U. made from coal and tar or a mixture of coal, coke, and tar with a carbonic oxide content of not more than 20 p.ct. Is there any reason why we should not only carbonize sufficient coal to produce coke for the carburetted hydrogen plant, and use all the tar produced as well—in fact, turn everything into gas and in this way produce the cheapest B.Th.U.?

Independent of the experience gained in the distribution of a 400 B.Th.U. gas in the district, a series of exhaustive tests have been, and are being, made on the works on gas engines, fires, cookers, and burners of all kinds. With gas-engine trials, it was found that the B.H.P. was not affected by the variation of the B.Th.U.; but the consumption of gas worked out practically in accordance with the B.Th.U.—that is to say, the consumption of gas of 400 B.Th.U. would be 20 p.ct. more than with 500 B.Th.U. The consumption of gas in fires and stoves works out the same; but with the incandescent burner, the 400 B.Th.U. has been found to be as economical and efficient as the richer gas. This is due to the efficiency of the burner being regulated or under control, and by simply opening or closing the tap to get the best results. Another advantage is that the burners can be turned low, or reduced as required, without lighting-back.

My experiences are certainly convincing me that a gas of 400 B.Th.U. is cheaper, better, and cleaner in every way, and is suitable for any purpose for which coal gas is used. There is one serious consideration bearing on the matter, and that is the fixed air inlet to all cooking, and a very large percentage of heating, appliances. The article in the "Journal" for March 20 (pp. 550-1) deals ably and fully with this matter; and I would strongly recommend your readers to carefully study and digest it. For cooking stoves there is no necessity or advantage whatever in using air. Then there would be no lighting-back, sooting-up, or smell.

I might add that, acting on my recommendation, my son (who is Manager at Bandon, co. Cork) is installing a carburetted hydrogen plant to work on the lines indicated.

SHOULD OFFICIALS VOLUNTEER ADVICE?

[Communicated.]

In the recently-issued Dardanelles report, it is stated: "We are unable to concur in the view set forth by Lord Fisher that it was his duty if he differed from the chief of his department to maintain silence at the Council or to resign. We think that the adoption of any such principle generally would impair the efficiency of the public service." Again: "We also think that the naval advisers should have expressed their views to the Council, whether asked or not, if they considered that the project the Council was about to adopt was impracticable from a naval point of view."

As a matter of abstract reasoning, few will be disposed to question the soundness of these *dicta*. An expert worthy the name has made the subject on which he is an authority the study and experience of many years. A wise man—even though placed in authority over the expert—would have the sense to ask, and be guided by, the latter's advice when subjects came up for discussion on which his training qualified him to speak. It is true that specialization has a tendency to narrow the mind (many specialists outside their particular groove are wofully ignorant), and that a man whose mind has been broadened by general culture and deep reflection is often capable of taking sounder views on many questions of principle and policy than is an expert. But when it comes to practical and technical matters—the possibility of doing such-and-such a thing with this or that means—the specialist's recommendations should be followed. The writer is well aware that experts (like doctors) often differ, and that one can hire them, like lawyers, to prove almost anything one wishes. If a stubborn expert is encountered, who will not trim his sails to every passing breeze—well, one can try another who, for a consideration, may be more complaisant. This, unhappily, is true enough; but no really eminent specialist has reached his position except by unusual and tested ability, and rigid conscientiousness.

The fact that an expert is not asked for his views does not exonerate him for maintaining silence when (say) a town council are drifting towards decisions which the former honestly believes would result disastrously. And yet (an official himself) the writer feels that there are often extenuating circumstances. Friction is abhorrent to all well-regulated official minds.

There is many an official who knows what it is to fight an internal battle between conscience and expediency. Take, for example, the case of a gas company's engineer and his chairman. The former has, perhaps, convinced himself that an additional gasholder is required to meet the growing demand. The chairman—looking at the question from the point of view of capital expenditure, and the maintenance of maximum dividends—will not give permission to the engineer even to bring the matter before the board. Time passes, and the need for the new holder becomes more urgent; but still the chairman objects. Wordy encounters take place; but no agreement is reached. Naturally, the engineer wishes to keep on good terms with his chairman; and so the question is allowed to lapse, although the engineer is fully persuaded that the result may be very serious. Or, to give another instance, the chairman may advocate a certain policy—say a scheme of differential charges for gas on a scale which the engineer considers unfair to the small consumers. The two men debate the question privately; but they fail to agree. The chairman brings the question before the board, and advocates it warmly; neither he nor any other director asking for the engineer's opinion. What ought the engineer to do? If he speaks against the proposal, and backs-up his argument with cogent reasoning and figures, he may succeed in obtaining a majority vote against the chairman, and in wounding that gentleman's amour-propre. If he says nothing, the chairman gets his way; and what the engineer honestly believes to be an injustice is inflicted upon a large number of consumers.

The situation is a difficult one; and it is impossible to lay down hard-and-fast rules for the guidance of officials perplexed in this way. From a pretty long experience of men and affairs, the writer can say that he has always found moral courage respected in the long run, even by those who do not show it themselves. Should it fall to the lot of an official to decide between compromising his conscience and speaking the thoughts that are in him, he should speak. But there is no reason why he should not speak tactfully, and with due regard to the possibility of being wrong. In the matter of the gasholder, for example, he might write a letter to the chairman, stating his reasons for considering that such an extension of plant is necessary, and end up with some such words as these: "I have thought it well to put my views on record, so that if any serious consequence should follow as the result of insufficient storage accommodation, I could not be held responsible." The chairman, on thinking matters over, might decide to put the subject on the agenda, and have it discussed and the decision arrived at duly minuted.

Another way to secure a proper discussion of matters on which differences of opinion exist between an official and his chairman is for the former to have an interview with one of the directors whom he can trust, and prime him with a few facts and arguments. The director would then initiate a discussion, in which the engineer or secretary, as the case may be, would probably be invited to take part. There is, however, some risk in this proceeding; for if a director's arguments and criticisms show unwonted point, suspicions are aroused in the minds of his colleagues, and the official who has done the priming may defeat his own object.

There are so many people who make up their minds without due thought and inquiry, or who express opinions first and think afterwards, that it is only a very small minority who, having once committed themselves to an opinion, seek absolute truth. Vanity steps in and blocks the way to right judgment, and views are defended, not with sound reasoning, but by clever fencing and dialectics. There is a greater desire to beat an adversary than to arrive at a right understanding. Shrewd people, therefore, listen carefully to arguments, and "cut in" at the end—often earning a reputation for clear-sightedness to which they are not justly entitled. The ideal state of things is, of course, for the chief to be a reasonable, open-minded man, who is always willing to discuss questions on their merits, and to listen with respect to views with which he may not agree. Such a man would not only invite but encourage his official advisers to give their opinions, and would thus never risk putting conscience and self-interest in opposition. "The wisest . . . need not think it any diminution to their greatness, or any derogation to their sufficiency, to rely upon counsel." Happy—thrice happy!—officials serving under such a chief!

Illuminating Engineering Society.—The annual meeting of the Society will take place on Tuesday, the 15th inst. At the conclusion of the formal business, there will be a discussion on "Economics in Lighting in Relation to Fuel Saving."

Pacific Coast Gas Association.—Members of the Pacific Coast Gas Association are already actively preparing for the twenty-fifth annual convention, to be held at Santa Cruz during the third week of September. An important feature will be an exhibition of gas appliances. The first exhibition of the kind held in connection with the Association's gatherings was in 1914; and so successful did the experiment prove that each year the appliance section has grown in importance. It is the purpose of the Committee to have an exhibition of appliances, for the benefit of members of the Association and the general public as well.

Brine for Clearing Frozen Service-Pipes.—The Minneapolis Gas Company have for fifteen years used brine for clearing frozen service-pipes. It is prepared by dissolving 22 p.ct. of salt by weight in 400 gallons of water, contained in an overhead mixing tank; solution being facilitated by continual stirring, and agitation with air-jets. The brine is piped to a tank-heater, in which it is heated to about 180° Fahr., and drawn off for use as required by the complaint men in 2 gallon cans. It will for some hours retain sufficient heat for use. The brine does not corrode the interior of the pipes, and is found to be in every way a satisfactory substitute for alcohol.

Institution of Civil Engineers.—At the annual general meeting of the Institution, the result of the ballot for the election of officers was declared. The President is Mr. W. B. Worthington, of Derby; Mr. H. E. Jones being again among the Vice-Presidents. Other members of Council include Mr. Charles Carpenter, D.Sc., Mr. Dugald Clerk, D.Sc., Sir Robert A. Hadfield, D.Sc., F.R.S., and Captain H. P. R. Sankey, C.B., R.E. (ret.). This Council will take office on the first Tuesday in November next. As to the awards for papers read and discussed during the past session, among these is a Telford Premium to Mr. J. L. Hodgson, of Luton, an abstract of whose paper on the "Commercial Metering of Gas, &c.," appeared in the "Journal" for April 10 [p. 64].

YORKSHIRE JUNIOR GAS ASSOCIATION.

A Meeting of the Association was held last Saturday week, in the Chemical Lecture Theatre of the Leeds University—Mr. J. E. LISTER COOPER presiding over a good attendance.

Mr. A. EDWARDS, Chief Chemist to the Leeds Corporation Gas Department, read a paper (which was illustrated by the aid of the blackboard sketches and tables and curve records on the lantern screen) entitled

GAS-WASHING, ANALYSIS OF PRODUCTS, APPLICATION TO THE CONTROL OF STILLS.

Gas washing by oil for the recovery of hydrocarbon vapours may be rendered an essentially automatic process, falling in line with the recovery of ammonia, hydrocyanic acid, and sulphuretted hydrogen, which years of experience have rendered purely automatic and readily worked by the non-scientific man. Since the process is a new one in its application to the washing of town gas, some account of the technical work necessary to establish the particular works' routine most favourable to good and economical recovery may be of interest to you. It can be stated at the outset, so far as crude benzol is concerned, that the necessary routine laboratory work, reduced to the simplest form, can readily be grasped by any intelligent man in charge of a benzol plant. Systematically recorded, the data will afford ample material for adequate technical control.

CONDITIONS FOR ECONOMICAL WORKING.

The initial skilled work necessary to establish the routine procedure involves a determination of the quantity of oil per ton of coal or per 10,000 c.ft. of gas necessary to absorb the benzol as completely as possible consistent with economy of steam. Theory indicates that it is impossible to remove the whole of the benzol without an infinite quantity of wash-oil. There is a dividing line, representing the most economical working, at some point in the range of oil used below which economy in steam is more than balanced by loss of benzol, and above which increasing recovery of benzol is more than balanced by increasing steam and water cooling demands. It is the chemical engineer's obvious duty to find the point for his particular plant and conditions, and arrange his control methods as simply as possible; so that, in the hands of the unskilled, they may afford him ample guidance.

Some of the conditions affecting the point are:

(*a*) Quantity of benzol in the gas.
(*b*) Type of gas-washer.
(*c*) Temperature of oil, which depends primarily upon the efficiency of the oil cooler and the temperature of the cooling water.
(*d*) Cost and pressure of steam.
(*e*) Cost of water.

Consideration of these items proves that it is impossible to lay down a hard-and-fast rule for the economical circulation of the oil. The coke-oven people, who have been running the process for years, appear to have arrived at the conclusion that approximately 100 gallons of wash-oil per ton of coal represents the best point. Detailed information is, however, somewhat meagre; and it is by no means certain that their conditions are the best or represent those of the average gas-works.

Considering (*a*), the quantity of recoverable hydrocarbon vapours is probably on the low side, since the method of carbonization in bulk and the fact that the gas is not supplied for general use, both point that way. In (*b*), we have a radical difference in the type of washer; the coke-ovens using the tower scrubber filled with boards, while most gas-works have put down mechanical washers of the usual rotary or newer centrifugal types. If the capacity of each type has been suitably designed, it should be possible to have approximating efficiencies, each of them extracting the same amount of benzol with equal flows of oil per ton. The cubical volume of the tower type would, however, exceed that of the other two, and, with its filling—which is the chief item—greatly exceed the cost of the others. The tower scrubber advocate counters this statement by pointing out that the steam, running costs, and repairs of mechanical washers must be considered against the static stability of the tower. Experience with mechanical washers proves that the charges under this head are a relatively small item in the total costs per gallon extracted. They could be exceeded by the extra steam entailed, due to increased oil necessary, if uneven distribution in the tower form—to which happening this type is very prone—failed to make the most of the static area provided. There is another circumstance connected with the mode of working of some tower systems which prevents an efficient extraction as distinct from efficient volumetric recovery.

The consideration of efficiency at once brings us up-against a problem; for there are to me three possible ways of looking at it. First of all we have the outstanding volumetric efficiency—the proportion which the actual recovery bears to the total quantity present. Secondly, we have the efficiency due to the method of applying the washing fluid. One might call it, for want of a better term, the "constitutional" efficiency—a constant for the particular method employed. Thirdly, we have the real "mechanical" efficiency of washing, which is represented by the relation of the theoretical minimum volume of oil necessary to arrive at final equilibrium between gas and oil, compared with the actual volume of oil found necessary. When the latter is 100 p.ct., the volumetric efficiency and the constitutional efficiency coincide. Coincidence of the constitutional efficiency with maximum volumetric efficiency can only occur when the former, together with mechanical efficiency, reaches 100 p.ct.

To obtain maximum efficiency, the flows of gas and oil should take place strictly according to counter-current principles through a series of saturations increasing by infinitely small stages. In a tower scrubber, an area of wetted surface is presented to the gas, and true counter-current flows can only be obtained if the washing medium travelled evenly and progressively over the surfaces. In rotary washers, the wetted surfaces in motion are presented to the gas in definite steps depending upon the number of chambers. Centrifugal washers depend solely upon agitation of the washing medium thrown about as spray; the action again being divided into definite steps corresponding to the number of sections. In both mechanical types six to ten chambers are used; eight being a common number.

The vapour pressures of mixtures of benzene and creosote oil obey approximately the expression for such pressures which states that they are directly proportional to the molecular volumes—that is, the partial pressure of the benzene is proportionate to its molecular concentration. This is a linear or straight-line function for any one temperature. Partial vapour pressures plotted against ordinary volume relations—where the molecular volumes differ very greatly—will be curved; but over the 10 p.ct. limit of benzene in wash-oil, above which it will not be necessary to go, the slope may be considered to all intents linear. This helps us to a consideration of the maximum possible volumetric efficiency of the particular method of washing—in fact, to the limits of constitutional efficiency mentioned before.

The proportion of benzene in wash-oil in equilibrium with benzene vapour in gas can be determined for any particular temperature. With these data, and by calculation from the known amount of benzene in the gas, the quantity of wash-oil theoretically required to absorb it at the temperature considered can be calculated. For instance, if 1 p.ct. by volume, or 7·6 m.m. partial pressure, of benzene in gas is in equilibrium with 5·75 p.ct. by volume of benzene in wash-oil, and 1 p.ct. by volume equals 2·3 gallons per 10,000 c.ft., the minimum amount of wash-oil necessary to absorb the benzene will be $\frac{2{\cdot}3 \times 100}{5{\cdot}75} = 40$ gallons per 10,000 c.ft. The method which uses this proportion of oil with complete extraction of the benzene must have 100 p.ct. volumetric, constitutional, and mechanical efficiency. As mentioned before, this can only be accomplished by counter-current flows with infinitely small stages of exchange between the phases.

If we consider a single chamber through which we pass the quantity of oil defined above, we shall find that full equilibrium is attained when 50 p.ct. of the vapour is absorbed and 50 p.ct. remains unabsorbed. Since equilibrium is attained, the mechanical efficiency of the method or apparatus is 100 p.ct.; the constitutional as well as volumetric efficiency is only 50 p. ct. From considerations of this character, washing systems of two, four, and eight chambers will have volumetric efficiencies of 75, 87, and 93 p.ct. respectively when working with 100 p.ct. mechanical efficiency.

The arrangement of tower scrubber working to which exception is taken is that where a couple are used in series, and where the fresh oil passing down the finishing washer in true counter-current style is re-circulated fast and furiously over the receiving washer. The receiving washer is converted, in effect, into a single chamber, and the advantage of the counter-current principle is lost. The bulk of the work is done by the finishing washer with a very low volumetric efficiency, or, if this is normal, with a low mechanical efficiency—that is, a large flow of oil per ton of coal and low concentration. The tower scrubber should theoretically have the higher efficiency if the true counter-current flow is established with ample area. But the difficulty of ensuring this will prevent full advantage being taken of the possibilities.

The temperature of the oil—consideration (*c*)—is as important as the type of the washer. The tendency of erectors is to underestimate the water-cooling area for the hot oil leaving the still. Gas-works with unlimited spring water available are few; so, for the sake of economy, water must be circulated *viâ* some form of air-cooling system. Under these conditions the temperature of the cooling water may exceed the air temperature by 10° to 15° C.; giving a minimum of 25° C. in summer, rising to 30° or 35° C. The conditions in winter are usually most favourable for cooling and extraction, despite the greater make of gas; for the temperature of the oil may be kept down to 12° to 18° C.

Town gas of 500 B.Th.U. net calorific value, produced in horizontal and inclined retorts, contains usually 0·8 p.ct. by volume of benzene vapour, or a partial pressure of 6·1 m.m. of mercury. From the data of benzene in gas-creosote oil phases (upon which work is still in progress), at the minimum summer temperature of (say) 25° C., 6·1 m.m. pressure of benzene vapour is in equilibrium with 3·75 p.ct. of benzene in the creosote wash-oil. By volume 0·8 p.ct. is equal to 1·83 gallons per 10,000 c.ft.; and this should require a theoretical circulation of 48·8 gallons per 10,000 c.ft., or, if the gas yield is 11,500 c.ft. per ton, 56 gallons per ton of coal. The actual possible yields with this quantity used

in washers with one, two, four, and eight chambers, together with the concentration of the benzene in the oil, are tabulated:

Washing System. No. of Chambers.	Yield. Gallons per 10,000 C.Ft.	Constitutional Efficiency. P.Ct.	Concentration in Oil. P.Ct. by Volume.	Not Recovered. Gallons.	
					P.Ct.
1	0·91	50	1·86	0·91	50
2	1·37	75	2·81	0·46	25
4	1·59	87	3·26	0·24	13
8	1·77	93	3·63	0·06	7
Counter current .	1·83	100	3·75	Nil	—

These figures stand unaltered for any other temperature—for the constitutional efficiency is a constant—except those for the concentration in the wash-oil, which will naturally vary inversely with the temperature. The figures for other temperatures are:

Temperature °C.	Benzene Concentration in Wash-Oil in Equilibrium with 0·8 p.ct. Benzene Vapour in Gas.
5 ..	9·8 p.ct.
10 ..	7·37 ,,
15 ..	5·75 ,,
20 ..	4·62 ,,
25 ..	3·75 ,,
30 ..	3·05 ,,

These results are interpolated from actual experiments covering the range, and are not the results of theoretical calculations for which the necessary data are not sufficiently known.

In practice, theoretical equilibriums are never attained, since the volume of the apparatus must be finite—thus limiting time contact, which is an all-important item. The figures do, however, point unmistakably to the limiting conditions, and have a direct bearing upon proposals that have been made for the use of one half of washer scrubbers for ammonia extraction and the other half for benzol recovery. If the whole washer had six or eight chambers, the use of three or four only for benzol must inevitably tend to loss of benzol and efficiency and high steam costs.

Experience with an eight-chamber washer points provisionally to the use of 1·1 to 1·5 times the theoretical quantity of wash-oil necessary for complete extraction, depending upon the volume of gas washed and the varying time contact. Critical observations, involving the time-factor, have not yet been made; so that more definite limits with their conditions cannot be given. Accepting the provisional limits, the practical circulation is, for 0·8 p.ct. by volume of benzene in gas and a temperature of 25° C., 53 to 73 gallons per 10,000 c.ft.

The cost of steam in consideration (*d*) is usually about half the total costs of recovery with fuel at normal prices. Any variation in the amount of oil passed through the still is immediately felt. Under (*e*) any increase in condensing and cooling water adds to the steam costs of pumping. The most disturbing effect of increasing oil circulation is felt at the end of the oil-cooler. If the areas are on the small side, the temperature difference between the oil and cooling water rises with the increasing flows, introducing new temperature equilibriums involving still greater circulations. The effect is sufficiently vicious from a costs point of view, with the added evil, in the case of gas-works as distinct from coke-ovens, of the naphthalene difficulty, which increases with rising temperature.

Having settled our rate of oil-circulation, the efficient practical working may be maintained by:

(*f*) Metering and recording the quantity of wash-oil used.
(*g*) Indicating or recording the amount of hydrocarbon vapours extracted.
(*h*) Indicating the volume of steam used in the crude still, so that predetermined volumes may be checked at sight.
(*i*) Periodic retort tests of the crude benzol.
(*k*) Examination of the wash-oil before and after the still for its content of recoverable product.
(*m*) Determination of the viscosity of the wash-oil.

Considering (*f*), the simplest instrument for measuring liquid flows applicable to creosote oil is the V notch weir. An angle of 45° is recommended with a depth of 6 in. The notch may be cut in ⅛-in. plate by the works mechanic, and mounted on a central division in a suitable tank, the size of which is governed by ease of access to the plate and ease of construction, with room for the introduction of a float of decent size. It is situated at a higher level than the washer, not necessarily near it, and connections run to the pump and washer. A float in the pump side of the tank, with rod and scale, completes the indicator. The flows may be calculated from the head of oil measured from the apex of the V to the level of the oil in the body of the tank, as indicated by the float and scale, which may be suitably graduated.

The following expression has been deduced from accepted formulæ for water flows, and includes the necessary correction for an average specific gravity of 1·05 and a coefficient of discharge of 0·6. Viscosity up to the limits so far found does not appear to materially influence the flow.

45° Notch Weir: Delivery.

$$\text{Gallons per minute} = 0{\cdot}8978\ h^{2{\cdot}5}$$

$$\text{or log. gallons per minute} = \log. 0{\cdot}8978 + 2{\cdot}5 \log. h.$$

The figures for every ½ in. are:

Inches .	0·5	1·0	1·5	2·0	2·5	3·0	3·5	4·0	4·5	5·0	5·5
Gallons per minute.	0·16	0·90	2·48	5·10	10·75	14·00	20 5	28·7	38·5	50·2	63·7

Instruments of this character can be purchased to record as well as indicate—at a price. The services of a handy man are sufficient to enable one to construct an instrument that will meet the needs of the case. By observing the strokes of the pump per minute simultaneously with the rate of flow given by the weir, the actual delivery per stroke can be found. The provision of a small counter, such as the Veeder, attached to some reciprocating part of the pump affords a very suitable substitute for the integrator of the commercial meter. The system also gives the surest indication of pump slip.

Where scrubbers are worked in parallel, both may be fed by the same pump, and V notches used to distribute the flow evenly between the two. In this case, a tank is divided into three portions by a couple of divisions; the notches being adjusted to the same level and to deliver into adjacent portions. In this case, the calculated flow from the head is doubled.

Considering (*g*), the total quantity of hydrocarbon vapours recovered can be followed at any moment by the use of a couple of jet photometers. A scale can be constructed by direct experiment showing gallons of hydrocarbons extracted per 10,000 c.ft. or other unit. Gas from a small holder was experimentally washed in a glass scrubber filled with crushed coke, down which wash-oil was allowed to flow at various rates. The hydrocarbon content (C_nH_m) before and after washing was estimated in the usual way by ordinary methods of gas analysis, and the decrease calculated to gallons per 12,000 c.ft., assuming a mean molecular weight of 83 and a sp. gr. of ·870. The figures were plotted against the difference of the readings of the jet photometers on the washed and unwashed gas.

After some experience of gas washing had been obtained, it was noticed that the appearance of an ordinary flat-flame produced by a No. 4 Bray union-jet burner gave a good indication of the extent of washing. The luminous portion developed a dark band, splitting this area into an upper and a lower luminous portion. It is our experience that when we wash sufficiently well to remove the upper portion of the luminous area, and make the dark band disappear, we have arrived at our economical limit of circulation, and the results are good. The point is exceedingly sensitive, and we habitually rely upon its indications. The quality of the gas is 500 B.Th.U. net, unwashed. With higher qualities, containing more ethylene, the peculiarities above may not be noted at the desired point. A few experiments with smaller burners should enable one to reproduce the conditions, or a battery of varying sizes may be used and observed experimentally over a wide range of qualities.

The benzene passing unabsorbed in the gas at this point is from 0·1 to 0·2 p.ct. by volume. Part of this amount, to a maximum of 0·026 p.ct. by volume, is, of course, due to the constitutional efficiency of our eight-chamber washer, and part to the small amount of benzene—0·1 to 0·2 p.ct. by volume—not extracted from the wash-oil by the steam distillation. Our benzene saturation figures point to 0·02 to 0·03 p.ct. of benzene vapour being in equilibrium with such an oil. We should therefore only allow to pass 0·046 to 0·056 p.ct. by volume if the mechanical efficiency of washing is 100 p.ct. The outstanding difference (0·054 to 0·154 p.ct. by volume) is due to the action of the time-factor. We could slightly increase the recovery by increasing the oil-flow, provided the temperature of washing was not raised thereby, but only at a cost increasing out of all proportion to the extra amount recovered. The possible volumetric recovery is thus from 93 to 94 p.ct., and the actual 75 to 88 p.ct.

If it is desired to indicate the quantity of residual vapours after washing, a third jet photometer may be used on the washed gas, passing this first of all through a small experimental scrubber fed with a continuous stream of wash-oil, used in quantity sufficient to reduce the benzol to a figure that may be neglected. The difference between the first and third instruments will give the total quantity recoverable; between the first and second, the actual recovery; and between the second and third, the quantity not recovered. Sight tests, such as those indicated, are a welcome addition to laboratory methods involving time and labour. Recording calorimeters used before and after the washing plant are useful. A differential instrument would be still more useful.

Considering (*h*), some form of steam-meter is very desirable. After working in the dark with fractional turns of a steam-valve, an indication in figures is welcome. If the holes in the steam distribution pipe, instead of being drilled in haphazard fashion, are calculated to pass the maximum quantity of steam at 10 lbs. pressure per square inch, and an open-scale gauge is fixed between the steam-regulating valve and the orifices, the scale of pounds per square inch serves as a flow-meter, and may have inscribed by its side a scale of pounds weight per minute or hour.

Considering (*i*), a distillation is conducted in the usual way from a retort to give the percentage by volume distilling at 120° C., with the bulb of the thermometer in the liquid. The methods under headings (*f*), (*g*), (*h*), and (*i*) are, with a record of the temperatures at various parts of the plant, sufficient to afford ample control, with the occasional supervision of a chemist. Under (*k*) and (*m*), tests may be conducted weekly so as to cut down skilled rountine work.

Consideration of (*k*) will be dealt with later.

Considering (*m*), the viscosity of the wash-oil affords the best

index of its useful life. Increasing viscosity is not favourable to good cooling. This will be evident when one considers that it is a measure of internal friction. Determinations may be made in the Redwood instrument at a temperature of 80° Fahr., or 26·6° C., which coincides fairly well with summer temperatures. Observations extending over a period dating from November, 1916, have given very useful information. The new oil has a viscosity of 7° R. (rape at 60° Fahr. = 100). This gradually increases in use to 23° R. with a simultaneous decrease of naphthalene content. Both remain stationary at this point for some time. Finally, the viscosity starts to rise again, increasing very rapidly to 40° R., at which point we have discarded it. As a maximum, the oil has reached 80° R. What the ultimate figure would be with continuous use I am unable to say. The viscous nature—comparable with a good lubricating oil—sorely tries the capacity of the serpentine cooler.

Analysis of Products.

Where crude benzol is alone made and sold on the usual basis of 65 p.ct., complete analysis of the product is a matter of academic interest, unless the proportion of paraffins is objected to. Where, however, the crude material is rectified for the production of standard or pure products, analysis must play an increasing part. There have been several excellent systems of analysis proposed, most of them for semi-pure products, which may be usefully combined for the analysis of crudes. If a sufficient quantity of crude benzol is rectified through a 12-bulb column collecting fractions—1, up to 80° C.; 2, 80° to 98°; 3, 98° to 127°; 4, 127° to 160°—the analysis of Nos. 1 and 2 may be conducted according to the methods of Spielmann, "first runnings" and "commercial benzols," respectively; No. 3 by Colman's method for toluol; and No. 4 by the boiling point method of my own. The latter refers to a paper given some time ago upon the determination of benzene and toluene in commercial mixtures. The method depends upon the separation of the aromatic hydrocarbons in pairs by fractionation, benzene+toluene below 110·7° C., toluene+xylene between 110·7° and 139° C. (a similar course forms the basis of the James method), and a determination of the boiling point of each pair. The boiling points of each pair may be calculated from the vapour pressures of the constituents, if known, or they may be experimentally determined from known admixtures of the pures, and plotted graphically as boiling point composition curves. The latter method is the one to adopt, for the results may be automatically compensated for errors in the thermometer—scale errors and those due to stem immersion. For some of the details the original paper must be consulted.*

I am anxious to give you short cuts and approximations, and emphasize points most useful to you. The boiling point determination is made in the apparatus illustrated.† The composition of the liquid phase is kept constant throughout by the use of a reflux condenser; a surrounding tube protecting the thermometer from spray. A miniature bunsen with a $\frac{3}{16}$-in. diameter tube may be used, surrounded by a wire gauze screen on legs. The wide-mouthed flask is supported by a sheet of asbestos millboard with a hole punched in the centre of it. A second screen, hinged in two halves, rests on the millboard and protects the flask from draughts.

Every thermometer used should be checked in the apparatus upon the pure constituents, with due allowance for the height of the barometer, and a correction curve obtained, which should be verified from time to time, as thermometers read high with age. The boiling point curves may then be constructed by admixture of the pures in 10 p.ct. steps, and the results plotted. It is advisable for each chemist to construct his own curves with the apparatus he has available. Of the curves given, that for benzene+toluene agrees very well with the figures calculated from their vapour pressures. The other has not been checked mathematically because the vapour pressures of xylene were not available. The method finds its greatest and simplest use in the analysis of pure or semi-pure products, and has special advantages in some cases, as it is seldom necessary to dilute with pures.

A large number of analyses of the crude benzol have been made, and several are given, each representing a week's production.

—	Week Ending				
	Dec. 1, 1916.	Dec. 15, 1916.	Dec. 22, 1916.	Dec. 29, 1919.	Jan. 12, 1917.
Benzene	53·23	56·90	54·01	55·52	50·70
Toluene	15·69	13·51	15·53	14·60	15·68
Solvent to 160°	4·65	3·62	6·38	4·75	5·50
Creosote	17·02	16·48	15·07	16·82	17·87
Unsaturated hydrocarbons	8·49	8·08	7·74	7·11	9·36
Carbon disulphide	0·23	0·43	0·34	0·25	0·24
Paraffins to 139°	0·68	0·88	0·89	0·94	0·62

The figures are for the ultimate or final proportions present. They do not give any indication of the distribution of the paraffins, or of those unsaturated hydrocarbons removed by strong sulphuric acid. The paraffins are important to-day, since their presence in benzene and toluene intended for the manufacture of explosives is objectionable. The unsaturated hydrocarbons must be washed out unless removed by distillation; and their presence, beside absorbing acid, may render the washing difficult.

Both paraffins and unsaturated hydrocarbons boiling below and above benzene as far as the boiling point of xylene, vary in a most unaccountable way from week to week, although the total amounts to 139° C. do not vary to a like extent. Unsaturated hydrocarbons shift up and down the scale of temperatures the most, possibly because these bodies are the half-way house between the aromatic hydrocarbons on the one hand and the paraffins on the other.

The boiling point method of analysis lends itself to a systematic survey of the range to 139° C.; and the figures given for two widely differing materials emphasizes the varying distribution:

—	A.		B.	
	Percentage of Fraction.	Percentage of Whole.	Percentage of Fraction.	Percentage of Whole.
Forerunnings to 80·2°—				
Benzene	29·9	2·81	63·85	9·18
Unsaturated hydrocarbons.	58·7	5·52	33·25	4·78
Paraffins	11·1	1 04	1·34	0·22
Carbon disulphide	0·3	0·03	1·56	0·19
	100·0	9·40	100·00	14·37
80·2° to 90·8°—				
Benzene	84·1	30·71	89·27	41·67
Toluene	8·1	2·95	5·80	2·71
Unsaturated hydrocarbons.	2·8	1·02	3·75	1·75
Paraffins	5·0	1·82	1·18	0·55
	100·0	36·50	100·00	46·68
90·8° to 110·7°—				
Benzene	39·5	4·66	40·44	2·28
Toluene	50·6	5·98	47·29	2·66
Unsaturated hydrocarbons.	4·8	0·56	8·95	0·50
Paraffins	5·1	0·60	3·32	0·18
	100·0	11·80	100·00	5·62
110·7° to 120·8°—				
Toluene	84·6	9·73	91·75	5·96
Xylene	1 3	0·15	0 55	0·06
Unsaturated hydrocarbons.	11·0	1·26	5·28	0·57
Paraffins	3·1	0·36	2·42	0·26
	100·0	11·50	100 00	10·85
120·8° to 139°—				
Toluene	40·4	3·91	10·68	0·29
Xylene	42·2	4·11	54·81	1·50
Unsaturated hydrocarbons.	15·4	1·49	32·00	0·88
Paraffins	2·0	0·19	2·41	0·06
	100 0	9·70	100·00	2·73
139° to 160°—				
Solvent naphtha	—	11·70	—	3·27
Creosote residue	—	9 40	—	16·43

A was extracted from mixed vertical and inclined gas.
B " " " " horizontal " " "

Collected, the figures for the ultimate composition are:

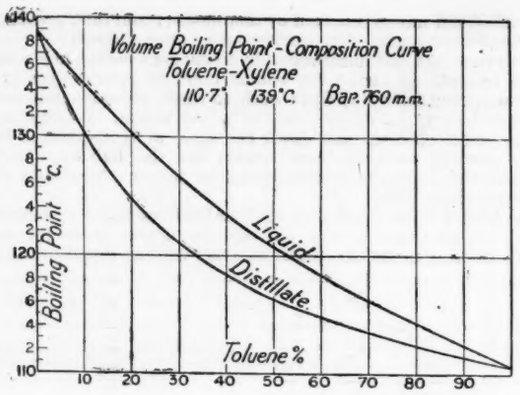
—	A.		B.	
	—	Less Creosote.	—	Less Creosote.
Benzene	38·18	42·15	53·13	63·63
Toluene	22·57	24·91	15·62	18·70
Solvent naphtha	15 96	17·62	4·83	5·78
Creosote	9·40	..	16·43	..
Unsaturated hydrocarbons	9·85	10·87	8 48	10 15
Carbon disulphide	0·03	0·03	0·19	0·22
Paraffins	4 01	4·42	1·27	1·52

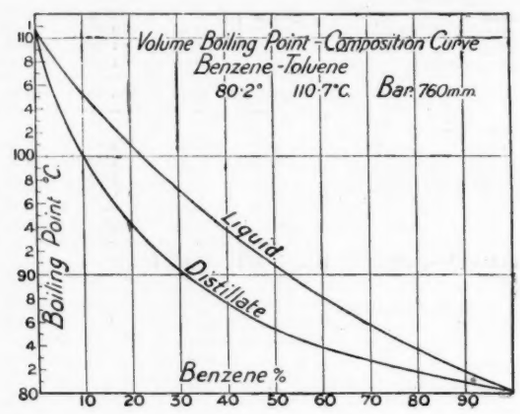
It will be noted that the unwashed material was fractionated in order to ascertain the distribution of both paraffins and unsaturated hydrocarbons. This is always preferable on the large scale, since the light boiling unsaturated material of the forerunnings assists in removing paraffins without undue loss of benzol. It also assists the subsequent washings of benzol. These low-boiling hydrocarbons go to pitch readily with strong sulphuric acid. The particular sample B, detailed above, does not represent an average quality—it is low in both carbon disulphide and low boiling paraffins.

The full scheme of operations for the analysis of a crude benzol is somewhat involved. A simpler method is desirable to afford some guidance for the working of the primary still. It has been pointed out by Young that, with mixtures of hydrocarbons, the proportions distilling between the arimethical means of the boiling points of the constituents, if an efficient fractionating head is used, directly represent the amount of the constituents present. It appeared to me that if, instead of the mean, we used those temperatures at which the constituents come over in 50 p.ct. mixtures, the results should more nearly approximate to the truth. We then desire to know the temperature of the still head at such a point.

* See "Journal" Vol. CXXXIV., p. 644.

† See "Journal" for June 20, 1916, p. 644, fig. 1.





Underneath the curves which show the composition of the liquid phase with the thermometer in the vapour, is another curve which shows the boiling point the vapour would have after condensation. It is derived from the relationship between the composition of the vapour phase in equilibrium with the liquid phase. The distribution between liquid and vapour is proportional to the ratios of the vapour pressures at the particular temperature. From the two curves it is possible to read off the composition of the vapour in addition to that of the liquid from which the vapour was produced. For instance, 50 p.ct. benzene + 50 p.ct. toluene boils at 90·8° C. The boiling point of the vapour when condensed is, from the lower curve, 85·5° C. By reference to the top curve horizontally, its composition is 71 p.ct. benzene and 29 p.ct. toluene. Working backwards from 90·8° C. on the lower curve, which must have the 50 p.ct. composition wanted, the still head temperature is given vertically on the top curve as 97·6° C. Similarly, 50 p.ct. toluene + xylene passes with a still head temperature of 126·7° C.

We have adopted these two temperatures as cut-points where a quick analysis of the benzol is desired for proportions of "once run" benzol, toluol, and solvent naphtha; taking the latter to 160° C. A 12-bulb column is used, and the scheme is: Up to 80·2°, forerunnings; 80·2° to 97·6°, benzol; 97·6° to 126·7°, toluol; 126·7° to 160°, solvent naphtha; residue, creosote.

It is now possible to refer to the analysis of the wash-oil before and after the still considered under (*k*). Here 4000 c.c. of oil are distilled to 240° C. in a metal still provided with a jacket. The water is separated and recorded, and the condensate distilled to 160° C. through a column. This represents the total benzol + toluol + solvent naphtha. It is dried by plaster of Paris and again fractionated, observing the volumes that pass over at the points mentioned for the quick analysis of crude benzol. Analyses of wash-oil and crude benzol collected over the same period are given. The percentage composition of the difference between the wash-oil in and out of the still should agree with the composition of similar items in the crude benzol.

	Wash-Oil.				Crude Benzol.	
	In.	Out.	Difference.	Composition.		Composition.
				P.Ct.		P.Ct.
Benzene . .	3·90	0·19	3·71	77·1	65·40	77·8
Toluene . .	0·95	0·20	0·75	15·5	12 98	15·4
Solvent . .	0·65	0·29	0·36	7·4	5·65	6·8
	5·50	0·68	4·82	100·0	84·03	100·0
Benzene . .	3·79	0·09	3·70	77·2	67·56	78·1
Toluene . .	0·99	0·21	0·78	16·2	13·36	15·4
Solvent . .	0·56	0·24	0·32	6·6	5·59	6·5
	5·34	0·54	4·80	100·0	86·51	100·0

It should be noted that the above concentrations in the wash-oil were obtained in cold weather, when the temperature of the oil was 14° to 15° C.

Working of Rectification Stills.

It is evident from a consideration of the boiling point composition curves that, in order to produce fairly pure products, the boiling points of the material delivering from the condenser must approximate to those of the pure constituent—for benzene 80·2°, toluol, 110·7° C. For solvent naphtha—which must not contain any toluol—the collection should not start until a boiling point of 139° C. is reached, as only at this point can xylene come over fairly free from toluol. At all intermediate points, the composition of the material can be read from the curves. It is only possible to obtain a good recovery of fairly pure material by a free use of the dephlegmator, returning down the column up to four times as much as is permitted to pass into the condenser.

When the material is pure, its boiling point and the temperature at the inlet to the condenser should coincide. The two sets of curves given indicate better than a string of figures the variation of the two temperatures with intermediate mixtures. The boiling point given on the lower curve has its corresponding still head or inlet to the condenser temperature vertically above it on the upper curve. Enough has already been said as to when the change-over points should be made. It should be possible to accept the reading of the still-head temperature; but steam leakages from the chests and tubes reduce it, and render it worthless. With sufficient steam present, the temperature will assume that of the hydrocarbon-steam phase—Benzene-steam 69·7° C., toluene-steam 84·8° C., xylene-steam 92·8° C.

Occasionally, when distilling-off benzol from a heavy charge of toluene-xylene, the still-head temperature falls to 65° C., when the condensate has a boiling point of 80·2° C. The effect is due to the production of permanent gas, from some decomposition taking place in the still, which lowers the partial pressures of benzene and steam, and thus lowers the temperature. It will be evident that a thermometer in the vapour will be of very little use. The boiling point of the condensate gives one all the information necessary. It can be performed more quickly than the usual fractionation from a side tube flask, and, owing to the use of the reflux condenser, it may be conveniently left for a few moments if necessary without danger, and is still functioning on return. The reading remains constant if the corks are tight, and allows time to book and verify it. The readings should, of course, be corrected for barometric pressure, and the use of a small aneroid barometer checked against a standard mercurial instrument is recommended as a necessary part of the complete plant.

In conclusion, those of you who are gas-washing will possibly notice that the estimation of the benzene in the gas, the full details of the benzene-gas-creosote equilibriums, and the estimation of naphthalene in gas and wash-oil, together with the very urgent naphthalene problem, all very burning topics, are not touched upon. I hope to return to these on some future occasions.

DISCUSSION.

The President said the meeting had listened to a highly technical paper on a very up-to-date subject, compiled with Mr. Edwards's usual and well-known skill. The paper was full of data and methods of working which anybody who was washing with oil would find valuable. It was, of course, quite impossible to do justice to it in discussion that afternoon. Much as had been said by Mr. Edwards, it was a subject which provided plenty of scope for discussion and further thought and study.

Mr. J. W. Lee (Chesterfield) said the paper had struck him as a step in advance of any that had been given during the past two years upon this important topic. In his opinion, it was a distinct advantage that the gas-works people were coming forward in order to do their part in assisting the coke-oven industry in the investigation of the problems of benzol recovery. His own experience as a coke-oven worker, and his previous experience as a gas-works man, made him think that there was a good deal more leisure in the laboratory of a gas-works than there was on a coking plant. There seemed to be a thousand-and-one things to do on a coking plant, which were taken for granted in the gas-works laboratory; and so there were, perhaps, more opportunities for the gas-works chemist to make inquiries. Their work and its results, therefore, were of particular value to the whole industry. It was of immense value that men of the ability and experience of Mr. Edwards should come forward with the results of their investigations and experiments. The points which he had laid down for the control of the benzol plant had, in his (Mr. Lee's) opinion, been quite correct. He had seen nothing that one could say was not necessary to the control of the plant; and he only hoped the time might quickly come when every benzol recovery plant would be conducted with these different points in front of the men. He was interested to know that the V notch had been used so successfully by Mr. Edwards in measuring oil. At his place, they had attempted to use meters; but his experience suggested that not one of the meters had proved to be really suitable. He had had some knowledge of the V notch in boiler work; and it had dawned upon him that it was possible to attempt its use in measuring the oil supplied to scrubbers. The test for viscosity of the wash-oil was one which had been very badly overlooked. He remembered some little time ago, in a paper which he himself read before the Association, he suggested how necessary it was to keep a close watch on the viscosity of the wash-oil. He would like to ask if Mr. Edwards was quite certain that it was possible to get a correct idea of the daily efficiency of the plant by means of a jet photometer. He would like to suggest to Mr. Edwards that it was still an imperative duty on his part to continue this valuable work, and to follow up, on

lines which would, one could only suppose, be much more difficult than even those of that afternoon's paper, the subject of the actual estimation of the amount of benzene in gas, which he had mentioned in his concluding remarks. He moved that the best thanks of the meeting be accorded Mr. Edwards for a paper which would advance in a very real way the methods that could be used to control benzol recovery plant.

Mr. J. ROPER (Bradford), in seconding, asked, as to the benzol left in the debenzolized oil, whether it was better to use high temperature and less live steam, or *vice versâ*, to get better washing.

The resolution having been carried unanimously,

Mr. EDWARDS, in reply, said it had certainly taken some time to produce the paper; and one or two of the features were deliberately introduced with the idea of obtaining some further knowledge. The efficiency of washers, for instance, in working for the extraction of benzol from gas, might possibly be materially improved. He was not sure whether his table of constitutional efficiencies was to be taken as absolutely mathematically accurate; and he would be glad of any corrections necessary. With reference to Mr. Lee's remark on the V notch, fortunately his (Mr. Edwards's) undertaking had one in use. They had employed it on liquor for a considerable time; and it seemed to answer very well. In trying to check it by the ordinary water-meter, they had found out the utility of the V notch, when the water-meter became choked and got out of commission. In commercial operations with big volumes of liquor in dirty neighbourhoods, it was impossible to keep the liquor clean, and any apparatus would become choked in time; but the V notch was simple, and the obstruction could be seen at once. At the same time, as a precaution, it might be examined once a week. As to whether jet photometers could give definite readings to indicate efficiency, everything depended on the quality of the gas. In his own case, there were no great variations in the gas quality; and the jet photometers gave a good index. The burners of the jets did make-up, of course, with obstruction; but the remedy was to use a burner rather larger than would otherwise be necessary, and put in a fixture in the nature of a choking screw, which was easily adjustable. In their case they had had this constructed, and it was working rather well. As to using steam and high temperature, they had to remember that there was a limit to the quantity of steam they might use. The best way to overcome any effect of benzene running in the wash-oil was to slightly increase the flow of oil per ton of coal carbonized, rather than increase the temperature or the steam.

WOOD IN GAS-MAKING.

In reference to the use of resinous woods for the production of gas, which has been adopted on a more or less extensive scale in several Continental countries ["JOURNAL," April 3, p. 18] a correspondent of the "Journal des Usines à Gaz" records his experience in the distillation of fir and oak in the Romorantin Gas-Works. The wood was distilled, unmixed with coal, in retorts of dimensions approximately 10 ft. × 25 in. × 14 in., in quantity to yield from 10 to 20 p. ct. of the make of gas from coal. Each charge was about 100 kilos. of fir or 120 kilos. of oak; and it yielded about 25 cb. m. (900 c. ft.) of gas. In working a bench of retorts, it was found necessary to adopt alternate days for the distillation of wood. Continuous use of the same retorts for wood gave rise to stoppages in the ascension-pipes in the shape of a viscous greyish deposit, very troublesome to remove.

The following figures were obtained for the cost of using the two woods:

FIR.—Price per tonne, 40 frs.; labour, 4 frs.; furnace coke (200 kilos. at 85 frs.), 17·50 frs.—Total, 61·50 frs. Deducting 50 frs. for the sale of charcoal (10 hectolitres at 5 frs.), the net cost is 11·50 frs.

OAK.—Price per tonne, 58·50 frs.; labour, 4 frs.; coke, 17·50 frs. Allowing for sale of 10 hectolitres of charcoal at 7 frs., the net cost is 10 frs.

The charcoal sells readily; the weight per hectolitre being 15 kilos. in the case of fir and 18 kilos. in that of oak.

OXIDATION OF COAL.

A recent communication to the Paris Academy of Sciences by MM. Georges Charpy and Marcel Godchot records measurements of the increase in weight experienced by desiccated coal on being heated for a considerable period at 100° C., while exposed to air.

Fourteen samples of coal were tested in this way. The coals, which were from St. Eloy (Puy-de Dome), Noyant, and Ferrières (Allier) were first dried by heating to 100° C. for three hours. On further heating at this temperature, they were found to gain in weight, very slowly up to a maximum increase of from 3 to 5 p.ct., which was reached in two-and-a-half to three months. At temperatures from 100° to 150° C., a similar change was observed; but the rate of oxidation was somewhat more rapid. Above 150° C., the action was different. Carbon dioxide was evolved, with continuous loss of weight. On treatment with potash solution, the oxidized coals yielded the brown coloration regarded as characteristic of ulmic bodies. It was also found that the calorific power was considerably less. The loss, as measured by combustion of the oxidized and unoxidized fuel in a calorimetric bomb, ranged from 3 to 13 p.ct.

From these observations, the authors lay stress on the fact that determination of the ash and of the volatile matter in a coal is liable to lead to erroneous conclusions as to its combustible value, since the process of oxidation may have progressed while the coal was in store. Thus, in the case of a Ferrières coal, the ash was 13 and 13·5 p.ct. in the raw and the unoxidized states respectively; and the volatile matter, 24·75 and 25 p.ct., showed similar agreement. Nevertheless, the calorific powers were 7617 and 6625 before and after oxidation.

OXY-ACETYLENE WELDED JOINTS.

At the recent meeting of the Illinois Gas Association, a paper on "Oxy-Acetylene Welded Main Joints, and Making 'Specials' *in Situ*," was read by Mr. E. E. Lungren, who alluded to the rapid growth of the process, and proceeded to give details relative to the laying of over 50 miles of welded main during last season.

Properly made-up welded joints, he said, were not only sound in the first place, but had every prospect of remaining so, which was more than could be said of other jointings; and they admitted of the use of extra heavy steel valves that did not require rubber expansion joints. Even if a leak occurred, due to a badly-made weld, its size led to immediate location and repair; whereas small leaks developed in screwed pipe that could only be discovered by barring. The joints in lead or screwed pipe were the weakest part; but a welded joint was stronger than the body of the pipe. Instead of cast-iron crosses, tees, bends, drips, &c., all specials were made up on the site where they were required. The only strain that a properly protected pipe line could sustain was that due to variations of temperature. A drop of 100° Fahr. would induce a shrinkage strain of about 20,000 lbs. per square inch—not greatly exceeding one-third of the ultimate strength of steel—so contraction would not reach breaking strain if the pipe was sound.

Opinions differ as to whether the pipe should be turned towards, or away from, the torch when welding. In the back weld, the flame was directed at right angles to the filling iron; and its advocates claimed that the draught tended to pile-up the metal and blow-out any slag that might be present. He preferred the forward weld; the flame being directed with a semi-circular motion along the plane of the filling. As the metal was subject to preheating in the reducing end of the flame—a benefit that was practically lost with the back weld—the fused iron was more readily controlled, and there was less danger of its flowing to a cool spot.

He had laid a five-mile run of 8-in. pipe, with no valves or fittings, except at the ends. As longer lengths than 20 ft. could not be shipped to the site, three welders and five labourers followed its distribution, and joined up every two lengths—averaging fifty welds per day, and completing this preliminary work in two weeks. An excavating machine, making a trench 4 ft. deep and 18 in. wide, set the pace for the pipe gang. It opened up 1400 to 1600 ft. per day, and, using the double lengths, three welders could easily keep up with it. At first, the pipes were joined-up on the surface immediately above the trench; the loose end being retained above ground to receive the next length. As the men became experienced in handling the pipe, sections of eighteeen to twenty single pipes were made-up before joining. Each welder had a helper; and a gang of five labourers lined-up and set the long lengths in proper position, or assisted in lowering. One welder made up the 80-ft. join, the second the 160 ft., a third the 320-ft., and then joined on to the loose end. Out of 1320 joins, only three were made below ground level. A welder averaged sixteen turning joins per day, or seven stationary and five turning welds; and on an emergency he had known a join to be completed in thirteen minutes.

The work was tested under 30 lbs. pressure in half-mile runs, as it proceeded. Each join was tested with soap suds, which revealed even the smallest pin-hole. In the first 190 joins there were 32 slight leaks, but these were steadily reduced as the work proceeded, and the last mile did not indicate a single leak. The man who made the stationary joins did not have a single fault during the whole job. The line was lowered into place by chain blocks while under pressure, and re-testing after settling was not found to be necessary.

The work included crossing a river 70 ft. wide and 2 ft. to 3 ft. deep, and it was required to carry the line 4 ft. below the river bed. A coffer dam having been carried out to the middle of the stream, and the excavation prepared, a double bend, to give a drop of 5 ft., was made on the spot, and the line extended to the end of the dam. After filling in it was removed. A second dam extended from the farther shore to meet the end of the pipe, the procedure was repeated, and a join-up was made *in situ* in the middle of the river. The run of the main ended in a cross with three 4-in. branches.

The cost of joining-up 4-in. screwed pipe, including an allowance of 4 in. lap at each join, was 4·72 c., and that of welding joins 4·67 c. per foot run. Corresponding figures for 8-in. pipe were 9·45 c. and 6·88 c. Some details of cost per foot on actual working in long runs are shown in the following table:

Size.	Lbs. Filling.	C.Ft. Oxygen.	C.Ft. Acetylene.	Total Cost.
1½ in. . .	0·076	1·50	1·37	0·1185
2 ,, . .	0·111	2·15	1·93	0·2378
4 ,, . .	0·375	5·34	4·65	0·9270
8 ,, . .	0·575	12·87	11·75	1·4200

The following table illustrates the economy of welded joins even in the congested districts of a large city, where obstructions are numerous:

Size.	Labour.	Acetylene.	Oxygen.	Filling Iron.	Total.
4 in.	17 c.	23 c.	18 c.	3 c.	61 c.
6 ,,	27 ,,	36 ,,	29 ,,	7 ,,	99 ,,
8 ,,	41 ,,	52 ,,	44 ,,	14 ,,	1·51 ,,
12 ,,	75 ,,	1·09 ,,	77 ,,	17 ,,	2·78 ,,
16 ,,	1·02 ,,	1·38 ,,	88 ,,	22 ,,	3·50 ,,

DISTILLATION OF COAL UNDER REDUCED PRESSURE.

A Review of Experimental Work and its Bearing on the Constitution of Coal.

Notable among the chemists who of late years have turned their attention to the investigation of the composition of coal is Prof. Aimé Pictet, of the University of Geneva, to whose work reference was made in the "Journal" for Dec. 26, p. 646, in the course of a general review of some of the recent research on this problem.

Prof. Pictet, in collaboration with other chemists, has carried out an extensive series of researches, in which he has sought to throw light on the proximate composition of coal by distilling it under greatly reduced pressure and at a much lower temperature than prevails in gas making—pursuing his further investigation chiefly in respect to the tar (exhaust tar) produced under these conditions. In a recent issue of the "Revue Générale des Sciences" he has published a *résumé* of his work of which the following is a translation, with the exception of the portion that deals with tests of solvents on the coal itself, which were made with the object of discovering to what extent compounds found in the exhaust tar exist as such in the coal. These later researches were the subject of a paper translated in the "Journal" so recently as Dec. 26 last, p. 645, that it is not necessary to repeat this portion of the communication.

In the dry distillation of coal under conditions of temperature (800° to 1000° C.) such as are adopted in the regular practice of gas making, the products which are finally obtained cannot be regarded as pre-existing in the coal, nor as the results of its immediate decomposition. From their chemical composition no conclusion can be drawn as to the more complex bodies from which they are formed. In the endeavour to avoid the profound modification which coal undergoes in these circumstances, the plan adopted has been to conduct the distillation at a much lower temperature and at a very reduced pressure. On these lines, he subjected to distillation under reduced pressure some kilograms of a free burning coal from the Montrambert beds of the Loire. He found that at a pressure of 15 mm. of mercury, distillation began at about 100° C., and was completely finished at 450° C.—that is to say below the temperature at which it usually commences under ordinary pressure. Moreover the products of the distillation were altogether different. They were:

1. Gas. The arrangements did not allow of the measuring the gas or ascertaining its composition, but it was observed that its odour was very different from that of town gas—more nearly resembling that of butadienes and isoprene.
2. Water. About 1·6 p.ct. of the weight of the coal, of acid reaction, and containing no ammonia.
3. Tar. Amounting to about 4 p.ct. and altogether different in appearance and properties from that ordinarily produced from coal.
4. Coke. Lighter, more friable, and more readily combustible than common coke, and approximating more to that obtained in the distillation of petroleum.

Of these products, that which was chiefly interesting was the tar. In order to obtain a sufficient quantity of it, 1½ tonnes of the same Montrambert coal were distilled under the reduced pressure by the Société pour l'Industrie Chimique at Basel, yielding 60 kilos. of the tar. This so-called exhaust tar is a clear light-brown liquid of slight greenish fluorescence. It is more fluid than ordinary tar, and possesses a very different odour—resembling that of petroleum. When first made, it floats on the water mechanically carried over with it; but it speedily becomes thicker, darker, and of greater density. At the expiration of three days, its density is 1; afterwards becoming greater. This phenomenon takes place both in the presence and absence of air, and is therefore not due to oxidation. In connection with this fact, it is to be noted that the tar, when stirred (soon after its preparation) with a weak solution of caustic soda yields nothing to this latter—that is to say, it is free from phenols. But these appear after a time, and their quantity increases somewhat rapidly.

On treatment with weak hydrochloric acid, the exhaust tar gives up to it a small quantity (about 0·5 p.ct.) of basic substances, which have been studied by M. Labouchere. Of these bodies, some are secondary, others tertiary, bases. They belong chiefly to the hydropyridic and hydroquinolic series. The only two which so far have been isolated in the pure state have the formulæ $C_{10}H_{11}N$ and $C_{12}H_{13}N$, and are most probably a dihydro-methylquinolene and a dihydro-trimethylquinolene.

After this double treatment with soda and hydrochloric acid, the exhaust tar still contains, as shown by ultimate analysis, about 2 p.ct. of oxygen compounds. These compounds, which can be removed by boiling the liquor with sodium, have the properties of alcohols. MM. Bouvier and Kaiser have been able to isolate by fractional distillation four well-defined representatives of this class of body corresponding with the formulæ $C_7H_{14}O$, $C_8H_{10}O$, $C_9H_{12}O$ and $C_{10}H_{14}O$. The first of these alcohols is a saturated body, and has the constitution of para-methyl-cyclohexanol (hexahydro-paracresol). The three others, which form a homologous series, belong to the group of non-saturated alcohols. Their constitution has not yet been determined, except that it is found that they are stable compounds, which at first are completely insoluble in alkalies but become partially soluble in a short time. The solution becomes turbid on the passage of carbon dioxide; and it is then possible to separate bodies having the odour and all the properties of phenols. This transformation is probably a species of isomerization.

After the removal of bases and alcohols, the exhaust tar consists only of a mixture of hydrocarbons, some of which are saturated, others unsaturated. In order to separate those of one type from those of the other, the Edeleanu process was employed, such as has been used for some years past in the refining of petroleum. It consists in thoroughly mixing the liquor, suitably cooled, with twice its volume of liquid sulphur dioxide. The non-saturated hydrocarbons only pass into solution, and can be recovered by simple evaporation of the solvent. The saturated hydrocarbons float on the sulphurous solution, and are separated mechanically. This process, applied to exhaust tar, has given excellent results, and has permitted of the two parts of the product being very sharply separated—the non-saturated hydrocarbons having a volume about double that of the saturated.

The two parts have been separately subjected to fractional distillation at intervals of 2° C. The behaviour of each was practically the same. Distillation began at 120° C. and finished at 350° C. There remained a small quantity of black substance of the consistency of asphalt. All the fractions, up to 300° C., remain liquid after cooling; none depositing any crystals. This shows that they do not contain any appreciable quantity of naphthalene, anthracene, or other solid aromatic hydrocarbon. As a result of oxidizing several with permanganate, there were obtained only acids of the fatty series—such as acetic, proprionic, butyric, oxalic, &c. It would thus appear that the exhaust tar, while it does not contain phenols, is free also from aromatic hydrocarbons.

A special study was made of the lower fractions. These are liquids insoluble in water and volatilizing with water vapour. They have the odour of petroleum, and are inactive towards polarized light. M. Bouvier has ascertained their composition, molecular weight, densities, and indices of refraction, and has succeeded in determining the constitution of certain of them by converting them into known bromo or nitro derivatives. His observations indicate the existence of the following compounds in the exhaust tar:

Saturated hydrocarbons, all of the same percentage composition, corresponding with the formula C_nH_{2n}. In other words, bodies of the cyclane series.

C_9H_{18}	—boiling point	135° to 137° C (hexahydro-mesitylene).
$C_{10}H_{20}$	,,	172 to 174 (hexahydro-durene).
$C_{11}H_{22}$	,,	189 to 191.
$C_{12}H_{24}$	,,	211 to 213.
$C_{13}H_{26}$	,,	227 to 229.
$C_{30}H_{60}$	,,	218° at a pressure of 0·5 mm.

This last hydrocarbon is solid at the ordinary temperature, and deposits in the last fractions (above 300° C.). It crystallizes from acetone in thin plates, melting at 62° to 63° C. It is found identical with melene, isolated by Brodie in 1849 from the products of the dry distillation of beeswax.

Of non-saturated hydrocarbons, several have been isolated in the pure state—viz., a dihydro-trimethyl benzene, C_9H_{14}, boiling at 163° to 164° C., and a hexahydro-fluorene, $C_{13}H_{18}$, boiling at 240° to 250° C. Moreover it is very probable that the lower fractions contain dihydrogenated derivatives of metaxylene, of mesitylene and of pseudocumene, since these hydrocarbons are produced by appropriate oxidations.

Thus all the constituents of exhaust tar, of which it was possible to determine the composition, belong to the hydro-aromatic series. The aromatic compounds in ordinary tar are replaced in the product by their hydrides. The homologues of benzene are replaced by those of cyclohexane and cyclohexadiene; phenols, by alcohols; and quinoleic bases, by their dehydrogenated derivatives.

It is known that these hydrides, when subjected to a high temperature, tend to lose part of their hydrogen, and to become converted into more stable aromatic bodies. It may, therefore, be assumed that a change of this kind goes on in gas-retorts, and that the hydrides of exhaust tar are formed in a first phase and that afterwards (at a higher temperature) they undergo dehydrogenation by heat. Exhaust tar would thus represent an intermediate stage in the formation of ordinary tar.

In putting this assumption to a test, 200 grams of crude exhaust tar—that is, before the removal of alcohols and bases—were caused to enter, drop by drop, an iron tube heated to a bright red, and previously filled with fragments of coke for the purpose of reproducing as closely as possible the conditions in a gas-retort. At the outlet of the tube were collected: 1. Gas (20 to 30 litres) possessing the smell of ordinary coal gas and burning with a luminous flame. It consisted of hydrogen and methane, with a little ethylene, but no acetylene. 2. Water, strongly charged with ammonia. 3. A tar of the appearance and odour of ordinary tar, and from which it was possible to

Exhaust Tar.				American Petroleums.				
Fraction ° C.	Formula.	Density.	Index of Refraction.	Fraction ° C.	Formula.	Density.	Index of Refraction.	Source.
135 to 137	C_9H_{18}	0·7590	1·4212	135	C_9H_{18}	0·7591	—	California.
172 to 174	$C_{10}H_{20}$	0·7765	1·4196	173 to 174	$C_{10}H_{20}$	0·7770	1·4149	Canada.
189 to 191	$C_{11}H_{22}$	0·7838	1·4234	189 to 191	$C_{11}H_{22}$	0·7832	1·4231	Canada.
211 to 213	$C_{12}H_{24}$	0·7862	1·4293	212 to 214	$C_{12}H_{24}$	0·7857	1·4289	Canada.
227 to 229	$C_{13}H_{26}$	0·7953	1·4379	228 to 230	$C_{13}H_{26}$	0·7979	1·444	Canada.

isolate: Benzene, toluene, and xylenes; phenols; a little naphthalene; anthracene; and pyridine bases. These are the chief constituents of ordinary tar. As they were found to be absent from the exhaust tar, the assumption, expressed above, would seem to be confirmed—viz., that the hydrogen and methane of coal gas, the ammonia of gas liquors, and the phenols and aromatic hydrocarbons of tar are none of them the direct products of the dry distillation of coal but are formed only at a higher temperature by the decomposition of other volatile, more complex, and more hydrogenated compounds produced at a lower temperature.

This conclusion is at variance with that of Berthelot on the formation of coal tar. According to the latter, it is assumed that, from the outset of its distillation, the coal decomposes into very simple substances—carbon, hydrogen, water, ammonia, methane, ethylene, and acetylene. In contact with the heated walls of the retort, the last-named gases, and particularly acetylene, undergo a series of polymerizations and condensations to form the various aromatic hydrocarbons in tar. In other words, the process is a synthetic one.

Berthelot based this theory not only on an actual study of the distillation of coal but on experiments on the effect of heat upon acetylene. These latter have been recently repeated on a large scale, but with identical results, by Herr R. Meyer, of Brunswick, and have shown, as is known, that at a dull red heat acetylene polymerizes, yielding benzene, that the two hydrocarbons unite in their turn with formation of naphthalene, and that it is possible, by successive condensation heat-changes of this kind, to obtain almost all the hydrocarbons found in tar.

Whatever may be the interest of these synthetic processes, it may be questioned whether they go on in the retorts of a gas-works. It seems to the investigator that it should not be taken as proved that coal, when heated, evolves large quantities of acetylene. In his view, this has not yet been proved to be the case.

This argument, however, would form a material objection to Berthelot's theory only if it was confirmed by new experimental facts. The study of exhaust tar may be said to have brought forward some such facts; and the newly proposed explanation of the changes which go on in the gas-retort may perhaps be proved worthy to replace in a large measure that which has been accepted hitherto.

M. Pictet remarks: I say "in a large measure" because my interpretation seems to me to be applicable to the major portion of the reactions which take place in the distillation of coal, since the latter yields almost the same quantity (4 p.ct.) of exhaust as of ordinary tar. Still I realize that it does not account for all the reactions. For example, we have not been able to find in our exhaust tar, any hydrogenated derivative of naphthalene. This hydrocarbon, so abundant in ordinary tar, would thus seem to originate in a different way from the others; and it is quite possible that it is formed by a synthetic process such as Berthelot conceived. It is proper to observe that we have found a very notable quantity of naphthalene to be formed when vapours of cyclohexane are passed over coke heated to redness. Benzene under these conditions yields diphenyl. Cyclohexane being among the saturated hydrocarbons which we have obtained from exhaust tar, this reaction may be the cause of the formation of naphthalene in ordinary tar.

Reference has been made to the analogies to petroleum which exhaust tar presents. These are marked not only by the physical properties of the two substances; they extend also to their chemical composition. After having isolated the series of cyclanes mentioned in an earlier paragraph, M. Bouvier and I compared their properties with those of naphthenes which form the essential portions of certain petroleums. It was seen that the naphthenes of Baku petroleum are not identical with the cyclanes of exhaust tar. For one thing, for a given formula, their density is greater and their boiling point higher. Yet we have found a remarkable concordance between the properties of our hydrocarbons and those which M. Mabery* attributes to naphthenes obtained from certain petroleums found in North America (Canada and California).

The above table records these points of resemblance. It cannot be doubted that the figures that are quoted in the table relate, in each case, to the same hydrocarbon. It should be added that the investigators have succeeded in extracting from the last fractions of the distillation of Galician petroleum a solid hydrocarbon of the formula $C_{30}H_{60}$, which has proved identical in all respects with melene of exhaust tar.

* "Journal of the American Chemical Society," Vol. XIX., p. 470; Vol. XXV., pp. 267 and 276; Vol. XXXIII., p. 264.

Thus the remarkable fact has been ascertained that, by simple distillation of coal, a series of compounds can be obtained which form an essential part of certain petroleums. It is believed to be the first time that such a chemical relationship between the two fuels has been established.

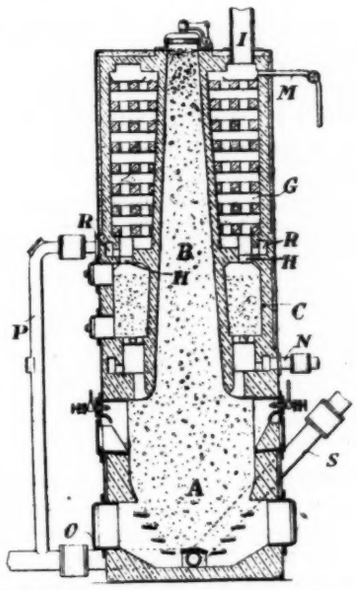
REGISTER OF PATENTS.

Manufacturing a Mixture of Hydrogen and Carbon Monoxide.

TULLY, C. B., of Victoria Street, Westminster.

No. 16,932; July 3, 1915.

This apparatus for producing hydrogen or hydrogen and carbon monoxide by the action of steam on highly-heated iron, embodies a superheater for the steam to be decomposed and a producer that generates gas for (in proper sequence) heating iron and reducing the iron-oxide and for decomposing the steam escaping decomposition by the iron.



Tully's Hydrogen and Carbon Monoxide Producer.

A diagrammatic illustration is given of one example of the apparatus. It consists of a lower combustion chamber A, a fuel supply chamber B extending upwardly, a reaction chamber C surrounding the fuel supply chamber and in communication at its lower end with the upper end of the combustion chamber through the openings, an annular space and ports, as shown; also through a chamber G that also surrounds the chamber B, and is in communication with the upper end of the chamber C through ports H. It is provided at the top with a waste-gas outlet pipe I with shift valve above, and is filled with refractory bricks arranged chequerwise to form a steam superheating chamber. M is a pipe for admitting steam to the upper end of the chamber G; and N is a pipe through which the hydrogen and steam escape from the bottom of C. O is a pipe for supplying an air-blast to the bottom of the chamber A, to which a jet of steam may also be admitted. P is a branch pipe for supplying air to an annular chamber R in communication with the bottom of the chamber G, and S is a pipe through which gases descending through (and in part produced within) the chamber A can escape therefrom. Controlling valves are fitted on the different pipes as shown.

Phenol and Intermediate Products.—No. 103,664.

AYLSWORTH, A. M., and SAVINGS INVESTMENT TRUST COMPANY, of East Orange, U.S.A.

No. 883; Jan. 17, 1917.

According to this invention, phenol is obtained by mixing a caustic alkali solution with a benzene derivative containing an element or group replaceable by the hydroxyl group—such as chlorbenzene or

sodium benzene sulphonate, forcing the mixture through a tube at a temperature above 300° C., and at a pressure exceeding the vapour pressure of the reacting substances, and then removing and decomposing the resulting alkali phenate. Using the apparatus shown in the drawings attached to the specification, caustic soda solution and chlorbenzene or sodium benzene sulphonate solution are pumped from storage vessels and the mixed solution is circulated through a heating-coil and pipes so as to effect a thorough mixing and preliminary heating. A part of the mixture flows out continuously to a reaction coil which is immersed in a bath of fused metal or salt—preferably sodium nitrite—maintained at the requisite temperature. The materials, after reaction, pass to a pipe which heats the preliminary heating-coil and thence to a **T**-piece connected on one side to a hydraulic accumulator which maintains the requisite high pressure (2000 to 4000 lbs. per sq. in.) in the reaction-tube, and on the other side to a cooling-coil. The liquid then flows into a mixing-vessel, in which it is neutralized by acid, and then passes to the phenol separators. The phenol is drawn off from the tops of these separators to vacuum stills, and the distilled phenol passes to a condenser and receivers. The salt solution is drawn off from the bottom of the separator to other vessels, where it is boiled to drive off any dissolved phenol, which passes to a condenser and receiver, where it is separated from the accompanying water. A modified form of apparatus, adapted for continuous or intermittent working, is also described.

Benzene sulphonic acid for use in the above-described process is prepared by heating for some hours an excess of benzene with concentrated sulphuric acid in a closed vessel at gradually increasing temperatures, then cooling and adding sulphuric anhydride in amount sufficient to combine with the water present, and then again heating. The operations of adding sulphuric anhydride and heating are repeated, if necessary, until the amount of free sulphuric acid remaining is very small. The benzene sulphonic acid may be converted into its sodium salt by means of the sodium sulphite obtained as a bye-product in the production of phenol.

Chlorbenzene for use in the process is prepared by treating benzene with chlorine produced by the electrolysis of brine. The bye-products —caustic soda, hydrogen, and hydrochloric acid—are employed respectively for obtaining sodium phenate, as fuel, and for decomposing the phenate.

The heating-bath of fused sodium nitrite (described above) is stated to be useful in carrying out various reactions—the production of aniline and naphthols is mentioned.

Gas-Burners for Lighting Purposes.—No. 104,778.

Tinsley, W. P., and Nash, J. G., of Fort Worth, Texas, U.S.A.

No. 5901; April 25, 1916.

This invention relates more particularly to burners for the utilization of hydrocarbon gases for lighting purposes. Its object is to provide burners for burning premixed gases and for liberating nitrogen during the process of combustion so that the nitrogen will not impede the combustion. "In this manner only can all the light producing units be utilized."

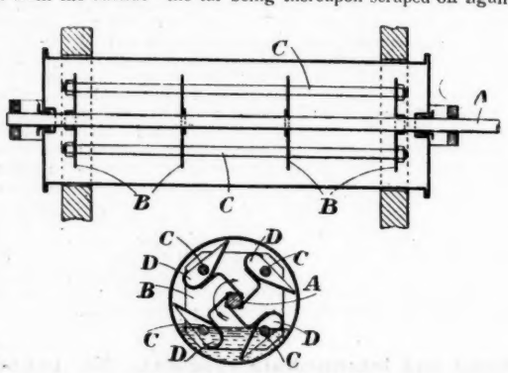
The patentees' claim is for: A gas-burner having a retarding chamber, closed against the admission of air; a pipe connecting the retarding chamber to a gas-main; a needle valve in the pipe controlling the admission of gas to the retarding chamber; a nipple screwed in the upper end of the retarding chamber; wire gauze across the passage from the retarding chamber, held in place by the nipple; and a burner cap engaging the nipple and holding another gauze in place.

Distillation of Tar.—No. 105,198.

Kilburn, B. E., D.; a communication from Sulzer Frères Société Anonyme, of Winterthur, Switzerland.

No. 12,837; Sept. 11, 1916.

This tar distillation apparatus comprises a horizontal drum having its external surface exposed to the heating gases; the heated inner surface of the drum casing being continuously covered with tar taken from the bottom of the drum by a scoop arranged in the interior and driven from the outside—the tar being thereupon scraped off again.



Sulzer's Tar Distillation Still.

A longitudinal section is shown with the scoops omitted, and a cross-section through the horizontal drum heated from the outside.

The drum (constituting the still) is provided with scoops driven from a line shaft by a belt pulley (not shown). In the interior of the drum, on the spindle A are mounted four sheet metal discs B with rods C on which are rotatably mounted altogether twelve scoops D, pressed by springs against the drum casing. Each scoop takes up tar from the bottom of the drum and spreads it on the drum wall above the level of the mass of melted tar. The next scoop removes the coating and replaces it by a new one. As shown, the scoops work over the entire casing surface of the drum exposed to the fire gases; and the patentees claim that the whole of its external surface is exposed to the heating gases.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for April 25.]

Nos. 5311—5633.

Evans, O. B.—"Manufacture of toluol, &c." Nos. 5567, 5568.
Hartley, H.—"Furnaces of the crucible, &c., type." No. 5336.
Ionides, A. C.—"Gaseous-fuel furnaces." No. 5352.
Johnston, J.—"Rotary compressors or exhausters." No. 5461.
M'Intyre, W. H.—"Explosive gas-engines." No. 5526.
Manchester Furnaces, Ltd.—"Furnaces for heat treatment of metals." No. 5570.
Pure Coal Briquettes, Ltd.—"Destructive distillation of carbonaceous substances." No. 5583.
Richmond Gas Stove & Meter Company.—See Hartley. No. 5336.
Rosenthal, M.—"Exhausters, blowers, &c." No. 5572.
Sutcliffe, E. R.—See Pure Coal Briquettes, Ltd. No. 5583.
Thuman, F.—See Evans. Nos. 5567, 5568.

Licences Granted.

The application of Bagley, Mills, & Co. for licences to use the Carl Still patents Nos. 22,862 of 1910 and 23,459 of 1910 [see "Journal" for Feb. 20 last, p. 359] has been granted by the Board of Trade.

"Free" Maintenance.

In the "Gas Record" [Chicago] Mr. H. H. Newman, of the Public Service Gas Company, New Jersey, writes strongly in favour of a system of "free" maintenance that has been in operation in one district for two years, and is now extended to include 100,000 customers. Calls are made three times a year, lamps and glassware cleaned and adjusted without charge, but mantles or other parts required for renewal or repair are supplied at current retail rates. The profit on sales of materials sold covers the cost of labour, and leaves a small balance of profit. Only well-trained men were employed; and he was opposed to giving them a commission or other direct interest on sales, as if these were the primary consideration the maintenance plan would suffer. The first object was to please the consumers by keeping the appliances in proper order. The inspectors regularly telephoned complaints received to the office; and if sent in before 3 p.m. they were attended to the same day. The inspectors carried a case weighing 22 lbs. when loaded, containing supplies of mantles, glass, and other parts likely to be required, tools, &c., and made a return each morning of sales on the previous day, with orders signed by the consumers for the goods supplied, and had their stock replenished to the full complement. They had triplicate receipt books for cash sales, so that the originals of all sales, cash or credit, could be handed in at the office daily. His experience showed that the expenses incidental to a maintenance scheme need not deter any gas undertaking from going into the matter, as good service was essential to success, and no effort should be spared towards making it as efficient as was possible.

Briquettes in the United States.—The production of briquettes in the United States during 1916 was 295,155 tons, valued at $1,445,662. These figures indicate an increase of 33 p.ct. in quantity and 40 p.ct. in value as compared with 1915; and the increase is attributed to the improvement in trade conditions, and to a growing appreciation of the value of briquettes as a household fuel. Many manufacturers have improved the quality of their product, so as to reduce the heavy tarry smoke that domestic users have found to be such an objection; and the future prospects of the business are excellent.

Broken Gas-Main Tragedy at Liverpool.—At an inquest in Liverpool on the body of Thomas Hignett, aged 66 years, who lived alone at Everton, it was stated that he was found unconscious in bed, with the room smelling strongly of gas. The gas was turned off at the meter; but the smell of gas still continued, and investigation proved that the escape came from a broken main outside. The gas had percolated through the soil into the house. Mr. J. S. Murray, of the City Lighting Engineer's Department, who had examined the meter and fittings in the house, testified that they were in perfect condition. There was nothing to account for the breaking of the main.

Haworth Gas Accounts.—At the last meeting of the Haworth District Council, it was reported that the gas account had increased by £451; and the Chairman said this and other figures bore out the statements of the Council's excellent financial condition. He was delighted with the gas account, in view of the extremely low rate at which gas was supplied. Mr. Ackroyd complained that this was being done with a plant costing £60,000, on which not a penny interest was paid. The Chairman: Every penny has been paid off. Mr. Ackroyd: And in every sense you are robbing the ratepayers. I put it to the Clerk whether it is a correct commercial condition. The Clerk: You are very fortunate in having paid off all the loans. I do not know another Council in such a position. Mr. Binns asked who Mr. Ackroyd wished them to pay rent to. Mr. Ackroyd said to the ratepayers, who owned the gas-works. Mr. Binns: We have been doing that by selling gas at a low price. Mr. Mitchell complimented the Gas Committee, and said he wished the Keighley Corporation, who supplied a portion of the district, could do as well.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Adulteration by Inert Gases and Dilution with Blue Water Gas.

SIR,—As a maker of blue water gas, I have naturally been very interested in the discussion on the above matter.

Careful methodical tests and records are at all times a difficult matter in small works, where the calls on the manager's time and attention are almost innumerable. During the last two-and-a-half years, shortness of staff and other difficulties brought about by war conditions, and the absolute necessity of removing the works to a new site, are conditions which have rendered such observations and records simply impossible. Even had they been made, they would have been worth but little, as a comparison with previous results. It would have been impossible to say whether such differences as would appear were due to the new carbonizing system, tar washing, or some other radical change.

My opinion on the matter under discussion is therefore based upon a careful watch kept upon the lights, gas-fires, and other apparatus under my own immediate observation, and an inspection of our "Complaints Book."

During the period above mentioned, I have, for various reasons, sometimes run for several weeks on straight coal gas and sometimes for several weeks on a mixture of coal gas and blue water gas. Our aim at all times has been to supply a gas of such a quality that users of the various forms of bunsen burners and gas-engines could not detect the difference.

Some variation in pressure it is impossible to avoid in any low-pressure supply system. [Incidentally absence of this variation is one of the many great advantages of high-pressure distribution.] These variations affect all atmospheric burners, even if the gas be of a perfectly uniform quality. When variation of quality occurs as well as variation of pressure, the result is frequently very annoying to the consumer.

We have noted that a mixture of blue water gas and coal gas is much less sensitive to the unavoidable variations of pressure, than is a coal gas that has perhaps been "over-pulled," and that where, with the latter, frequent adjustment—particularly of inverted incandescent burners—is necessary, it is not so with the former gas.

Circumstances quite apart from the works are now making such demands upon my time, that I am really unable to write more fully, much as I should like to support Mr. Glover, Mr. Settle, and others who do not believe in sending out large percentages of inert gas.

P. P. CHANNON.

Haywards Heath, April 24, 1917.

Welsh Gas Prices.

SIR,—At the annual meeting of the Wrexham Gas Company, Mr. J. Oswell Bury, the Chairman, is reported in the "JOURNAL" for April 17 to have stated that their price for gas for lighting purposes through ordinary meters (2s. 9d. per 1000 c.ft.) was the lowest price in the whole of Wales. I would like to point out that this is also the price charged by the Merthyr Tydfil Gas Company.

JAMES E. KENSHOLE,
Engineer and General Manager.

Merthyr Tydfil, April 23, 1917.

Greetings to America.

SIR,—I am desired by my President, Mr. A. E. Broadberry, to ask if you will be so good as to insert in your next issue a copy of the accompanying letter which has been sent to the Secretary of the American Gas Institute.

WALTER T. DUNN, Secretary,
Institution of Gas Engineers.

39, *Victoria Street, S.W., April 23, 1917.*

[ENCLOSURE.]

April 20, 1917.

Geo. G. Ramsdell, Esq., Secretary,
American Gas Institute.

My dear Mr. Ramsdell,—I wish you and all the other members of the American Gas Institute were in London to-day. "Old Glory" and the "Union Jack" are flying everywhere. On the staff of the Victoria Tower of our Houses of Parliament the two flags are flying as one. We thank God that our brethren of the States are with us in this great conflict in the cause of freedom, justice, and humanity. It must bring us within measurable distance of the conclusion of hostilities.

With the sincere greetings of the British Institution of Gas Engineers to the American Gas Institute on this joyful occasion, believe me always to be

(signed) W. T. DUNN, Secretary,
Institution of Gas Engineers.

Petroleum Supplies Pool Board.—A controlling board, which will be known as the "Pool Board, Petroleum Supplies," and will consist of representatives of the various companies, has been appointed by the Government, with Mr. E. Houghton Fry (Director of Munitions Petroleum Supplies) as Chairman, so that distributing facilities in this country may be pooled, as well as the tonnage employed in bringing supplies to the United Kingdom, with the object of releasing men and effecting economy. All products, except lubricating oils, hitherto delivered under proprietary brands, will in future be delivered under war brands, and distributed under the authority of the Pool Board. Inquiries with respect to supplies should be addressed, as heretofore, to the offices of the respective companies.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Gas Light and Coke and other Bills.

The Bill of the Gas Light and Coke Company was read a first time, and referred to the Examiners.

The Haslemere and District Gas Bill, the Hemel Hempstead Gas Bill, and the Lea Bridge District Gas Bill have been reported, with amendments.

The Kenilworth Gas Bill will come before the Unopposed Bills Committee to-morrow.

HOUSE OF COMMONS.

Sheffield United Gas Company's Bill.

Next Thursday has been fixed for the consideration in Committee of the Bill of the Sheffield United Gas Light Company.

Charing Cross Railway Bridge.

A House of Commons Committee last Thursday found the preamble proved of the South-Eastern and London, Chatham, and Dover Railway Bill, for strengthening the Charing Cross Bridge—see p. 196. The London County Council were the only opponents; the petitions having been withdrawn of the Gas Light and Coke Company, the South Metropolitan Gas Company, and the Wandsworth, Wimbledon, and Epsom District Gas Company.

Coal Miners and Recruiting.

Mr. DUNCAN MILLAR asked whether a special appeal for recruits for the Army had been issued to the miners of England, Scotland, and Wales; and what was the number of men whom it was estimated could at present be obtained from the mining industry, without affecting the necessary output of coal.

Mr. MACPHERSON said that the answer to the first part of the question was in the affirmative. The point was now being considered as to what extent more miners could be spared for military service, having in mind the requirements of coal. Pending this consideration, it was not possible to give an answer to the last part of the question.

Consumption of Raw Coal.

Sir FORTESCUE FLANNERY asked the Prime Minister whether it was the intention of the Government to appoint a Select Committee or other means of inquiry into the consumption of raw coal during war time, and the consequent waste of bye-products required for national service, with a view to formulating such restrictions as will increase the quantity of explosives and dyes that are now urgently required for national service.

Mr. BONAR LAW replied that the general question of economy in the consumption of fuel of all kinds has been entrusted by the Government to the Fuel Research Board, which is under the direction of Sir George Beilby.

LEA BRIDGE DISTRICT GAS BILL.

This Bill, which was reported for third reading by the Unopposed Bills Committee of the House of Lords last Tuesday, has for its main object the raising of additional capital, to the extent of £200,000, including premiums, with one-third borrowing powers. The Bill also confers a number of general powers upon the Company.

The clause relating to the construction and maintenance of gas-works now has the one-third limitation as regards the working-up of residual products; but this did not appear in the Bill as originally drafted. Powers are given to create a reserve fund out of profits available after the standard dividend has been paid; and this fund is to be used for making-up the dividend to the standard in any year when the profits are not sufficient to pay the standard rate. The Company are also authorized to subscribe to funds for institutions within their area of supply, and also to pay benefits to employees injured and dependants of employees killed in the war. Under both these heads, however, the amount so subscribed must not exceed ½d. per 1000 c.ft. of gas supplied during the year. Powers are also given to grant pensions to officers and servants other than weekly servants. Other clauses deal with the purchase of gas in bulk in a crude or partially purified state; and the price for gas may be varied according to the purpose to which it is put, provided no preference is given as between consumers taking a supply of gas for the same purpose in like circumstances.

HASLEMERE AND DISTRICT GAS BILL.

This Bill, which was last Tuesday sent forward for third reading by the Unopposed Bills Committee of the House of Lords, provides for the dissolution and reincorporation as a statutory concern of the Haslemere Gas Company, registered as a limited Company in 1868.

The present share capital of the Company is £26,435, of which £10,500 is entitled to a maximum dividend of 10 p.ct. and the remainder to 7 p.ct. As originally drafted, the Bill proposed to raise £18,000 additional capital; but this has since been reduced to £15,000. The capital may be issued (to be redeemable) either as preference shares or stock or as debenture stock. The borrowing powers are the usual one-third of the capital issued at the time of borrowing; but this is to include £6200 already borrowed by the limited Company. Here, again, there has been an amendment in the original Bill, where the

borrowing powers were to be one half the issued capital, including the sum already borrowed. The new capital carries 7 p.ct. dividend. Additional lands are authorized; and the powers of the Godalming Gas Company to supply in a portion of the parish of Witley, now within the Haslemere Company's area, are repealed. Though the maximum price mentioned in the original Bill was 5s. 3d., this has now been reduced to 5s., with provision for the Board of Trade, after three years, to alter the maximum price or apply the sliding-scale. The third schedule to the Bill sets out the terms upon which the sliding-scale would operate after the standard price has been fixed. These include powers to create a special purposes fund and a reserve fund. A calorific test of 500 B.Th.U. is adopted, and a pressure of 15-10ths over the greater part of the area, and 10-10ths over the remainder. Clause 68 gives the right to the Company or any local authority or person "who may appear to the Board of Trade to have a substantial interest," to apply for a reduction or increase of the calorific power test. Special clauses have been inserted giving protection to the London and South-Western Railway Company as regards laying mains, and also to the Haslemere Urban District Council. In the case of the Railway Company, plans have to be approved by the Company's engineer within 21 days; and if the Company prefer to lay any mains that require to go under or across any level-crossing, they may do so at the expense of the Gas Company. The local authority are to have seven days' notice instead of three of the intention of the Company to lay new mains. The clause for the protection of the County Councils of Surrey, Southampton, and West Sussex contain sixteen sections; seven days' notice again being given instead of three. In the case of a bridge, the notice is to be one month; but no mains may be laid without the consent of the County Council.

HEMEL HEMPSTEAD GAS BILL.

The Unopposed Bills Committee of the House of Lords last Tuesday sent this Bill forward for third reading. The main objects are an extension of the area of supply and the raising of additional capital. There have been a large number of amendments to meet the opposition that existed before the Bill was transferred from the opposed to the unopposed list. These will be dealt with later.

CHARING CROSS BRIDGE STRENGTHENING.

Gas Companies Protective Clause.

The Bill of the South-Eastern and Chatham Railway Companies, which deals with the strengthening of Charing Cross Bridge, was last Thursday passed by a Select Committee of the House of Commons. Last year a similar proposal was subjected to a considerable amount of opposition, not the least of which was that of the Gas Light and Coke, the South Metropolitan, and the Wandsworth Gas Companies. This year, however, the opposition dwindled-down to that of the London County Council only. The following clause appears in the Bill for the protection of the three Gas Companies named:

(1) No part of any new pier or similar work to be constructed in the river shall project at the top thereof more than 12 ft. beyond an imaginary line drawn through the centre of the existing columns supporting the said bridge, nor shall the outward batter of the face of any such pier or similar work exceed 1 in 35.

(2) The springing of the arches or cantilevers at the face of any pier or milar work shall be at a level not lower than 10 ft. 9 in. above Trinity gh-water mark.

(3) The Company shall repay to the Gas Company all expenses incurred by the Gas Company during the progress of the said works, and until such time as all temporary works have been removed, in providing a steam tug of adequate horse power for the purpose of assisting their steam-vessels proceeding up or down the river between Limehouse and the works of the Gas Company. Provided that the paymert to be made to the Wandsworth, Wimbledom, and Epsom District Gas Company shall not exceed the sum of £750 per annum. The provisions of this sub-section shall be in addition to, and not in derogation of, the provisions of sub-section (5) of the section of this Act of which the marginal note is "For Protection of Port of London Authority."

(4) The Gas Company and the master of any vessel or barge belonging to, or worked by, them shall not be liable to make good any damage which may be caused to any works, either temporary or permanent, constructed under the powers of this Act, except such as may arise from the wilful act or default of the Gas Company or the masters of their vessels and barges or their servants or agents

(5) If any difference shall arise between the Gas Company and the Company under this section, such difference shall be referred to an arbitrator to be agreed upon, or, in case of difference, appointed (on the application of either party) by the Board of Trade; and the Arbitration Act, 1889, or any statutory modification thereof, shall apply to such reference.

Lurgan and the Maximum Gas Price.—The question of applying for a Provisional Order to enable them to increase the maximum price to be charged for gas to 6s. 6d. per 1000 c.ft. has been postponed by the Lurgan Town Council until the gas-works accounts for the past year are audited. It was stated that on last year's working there was a deficiency of £500; and the Manager anticipates a similar deficiency this year unless the present maximum price of 4s. 6d. is raised. To meet the two years' deficiency it would be necessary to increase the price 6d. per 1000 c.ft.

Rotherham Gas-Works Results.—The report of Mr. J. S. Naylor, Gas Engineer and General Manager to the Rotherham Corporation, states that for the past year the gross profit amounts to £15,708, as against £16,449 for the preceding twelve months. This is a decrease of only £741. There is a net profit of £5883, which is £1197 less than a year ago. If the gas for public lighting (£176) is again given by the department, as in former years, and a sum of £1300 is set aside as before as a provision for excess profits duty, there will remain an available surplus profit of £4408—a decrease of £347.

LEGAL INTELLIGENCE.

THE WOODALL-DUCKHAM PATENT.

Controller's Power of Extension.

An important judgment was delivered by Mr. Justice Sargant in the Chancery Court last Tuesday upon an originating summons brought in respect of the Woodall-Duckham patent, No. 16,497 of 1903.

The invention has for its object the continuous production in one and the same retort of coal gas simultaneously with the manufacture of water gas, which latter is enriched to some extent by the hydrocarbons which would otherwise be deposited in the production of coal gas. A vertical retort is employed, the lower end of which dips into a water sump, where there is a conveyor continuously lifting coke from the retort. The coal is fed into the top of the retort through a shoot, by a cool gas-tight feeding device, which works in such a manner that both the shoot and the retort are under all conditions full of coal, and yet the charge does not jamb.

Mr. Hunter Gray stated that the originating summons asked for his Lordship's decision on a novel problem. The question was whether the Controller of Patents had the power to extend the time for filing a petition to extend the life of a patent. The new rules favoured the idea that the Controller had this power, and that the Court did not possess it. It was necessary to come to his Lordship for a declaration upon this point. The period in which notice could be lodged of a petition to prolong a patent's life was six months before the patent normally expired. Counsel then cited the various clauses which bear upon the matter.

His Lordship decided that the Controller of Patents had the power to extend the six months' term in which a petition might be lodged to give a patent a longer existence than fourteen years.

CHARGES AGAINST AN EX-SECRETARY.

At the Haywards Heath Police Court, last Saturday week, Russell Cory, ex-Secretary of the Haywards Heath and District Gas Company, was charged on remand with forging and uttering two cheques, for £68 13s. 9d. and £88 5s., and with falsification of accounts with intent to defraud the Company.

In the first two cases, it was alleged that cheques in payment of accounts had been altered in amount and then appropriated by the defendant, instead of being forwarded to the firms to whom the original sums for which they were made out were owing. The third charge, it was explained by Mr. G. F. Donne (who appeared for the prosecution), arose out of the system of making rebates to users of slot-meters. These repayments were made once a year by the Manager, and defendant had nothing whatever to do with them. When the accounts were investigated it was found that defendant had received a cheque for £91 17s. 2d. for rebates.

The Manager, and now Secretary, of the Company (Mr. P. P. Channon) said it was his duty to pay rebates on slot-meters. In 1915, the amount came to £91 17s. 2d. He produced a list of the rebates. The date of payment varied from May to June. The entries in the ledger produced were in defendant's handwriting. He had charge of it. Under June 30, 1915, there were entries: "Allowances, 1s. 4d.; slot rebate, £91 19s. 4d." Under date Dec. 31, there was the entry: "Allowances, £91 17s. 2d." These entries were on the debit side. In the cash book the entries were in defendant's handwriting. Under date July 21, 1915, there was the entry: "Slot-rebates, £91 17s. 2d." Witness only paid the rebates once a year. He did not ask defendant to get a cheque for £91 17s. 2d. signed, and the amount of the cheque never reached him. In 1915, witness paid the whole of the rebates out of petty cash.

Mr. W. H. Reeves (a Director of the Company) said the cheque for £91 17s. 2d. bore his signature. To the best of his belief, defendant brought the cheque to witness's office to sign, and explained that he had to give the money to the Manager, who distributed it to the consumers. Defendant told witness he had been to see the Chairman, who knew all about it. Defendant afterwards took the cheque to the bank to be cashed.

Mr. R. D. Higgs (a chartered accountant) stated that he had been engaged on the books of the Company for the past few weeks; and it was on the results of his investigation that the charges were made. In his opinion, alterations in the books were made to bring certain amounts to £91 17s. 2d., the sum for which the cheque was drawn, and which was the amount the Manager disbursed as rebate for slot-meters.

Defendant, who pleaded not guilty and reserved his defence, was committed for trial to the Assizes.

The Magistrates having considered in private the application for bail, the Chairman said that, in the exceptional circumstances, defendant having joined the Army, they had decided to release him on bail in his own recognizances of £100 and in two sureties of £100 each.

NINETEEN GERMAN PATENTS FOR COAL-TAR DYES.

An extensive development of the British use of coal-tar products was foreshadowed last Thursday in the Patents Court, which has been set up to deal with the patents of alien enemies during the war. Major Lionel Brook Holliday, on behalf of Messrs. L. B. Holliday & Co., of Huddersfield, applied for licence to use nineteen German patents for the manufacture of dyes. All the patents [which were enumerated on p. 152 of last week's "Journal"], except one—No. 10,324 of 1906, in the name of the Badische Anilin und Soda Fabrik—were applied for on Feb. 22 by British Dyes Limited.

This particular patent covers an invention for producing colouring matters of the anthracene series—those in which three anthraquinone

groups are joined together by means of nitrogen. The manufacture proceeds by causing two molecular portions of 2-chloranthraquinone to re-act upon one molecular portion of diamidoanthraquinone. Of a given example, the specification says: "It is insoluble in water, in alkalies, and in hydrochloric acid. Concentrated sulphuric acid dissolves it; the solution being bottle-green, which, upon warming, turns greenish-blue. It is soluble to alkaline hydrosulphite, yielding a yellowish-red vat, which dyes cotton red shades."

Mr. COLEFAX, K.C., for the applicants, explained that the patents fell into five groups. Major Holliday, said Counsel, was Director of the firm of Read Holliday and Sons, which was taken over by British Dyes Limited. Since the latter Company were formed, Major Holliday had built works for the applicant firms on 32 acres of ground at Deighton, Huddersfield, on part of which he had been engaged manufacturing a certain substance for the Government. In addition, he had also carried on the manufacture of dyes there, employing the firm's own patents and patents which had lapsed. He employed a staff of highly trained chemists, eminently able to conduct research work. They had conducted this work for him before, and plant had been ordered for manufacturing under these patents. This plant would shortly be available, and represented many thousands of pounds. The firm had laid their plans in anticipation of the grant of this licence, and it was agreed that there was scope, in supplying the British calico printers and the Bradford dyers, for all that both British Dyes Limited and Messrs. L. B. Holliday and Co. could do in the production of dyeing material of a wide range of hues. British Dyes Limited were not opposing the present application. The application revealed a determination on the part of a really British concern to tackle the important problem of providing the British market with first-rate and economical dyeing substances of home manufacture.

Major *Holliday* told the Court that he had ordered plant costing many thousands, which would enable them to get to work during May, and had taken steps to obtain the raw material. He had already promises from the Government as to some of the materials. He had had many years' experience of this kind of work, and Messrs. Read Holliday and Sons had a long history of research work. The business was founded in 1820. He offered a royalty of 2½ p.ct. on the selling price of the produce made under the patents. These were the terms offered by British Dyes Limited.

Dr. *Arthur Clayton*, head chemist of the applicant firm, said they were going to produce vat dyes and shades of as wide a range as it was possible to secure.

The CONTROLLER OF PATENTS (Mr. Temple Franks): Do you think you will be able to satisfy the colour printers of Great Britain in the future?

Witness: I do not see why we should not.

Mr. JOHNSON (for the Controller of the Mersey Chemical Works) suggested that as British Dyes Limited was being supported in a financial sense by the Government, the special terms granted to them should not be the terms granted to Messrs. L. B. Holliday & Co. British Dyes Limited should be regarded as in a category apart.

The CONTROLLER: On the contrary, I am so impressed by the boldness of Major Holliday in coming forward without this support, that I think he ought to be encouraged. British Dyes Limited are not opposing the application. We shall treat these applications on the footing simply that we wish to stimulate the establishment of dye-works in this country for the manufacture of English dyes. There is room for all. I think there is no question that we shall grant this application substantially on the royalty basis suggested by Major Holliday. To fix a higher percentage than before would simply penalize the present enterprise. We intend to promote as far as possible the British development of the industries employing coal-tar products.

Gorey (co. Wexford) Gas and Water Company, Ltd.

In the Chancery Division of the High Court of Ireland, before Mr. Justice Barton, the matter of the Gorey Gas and Water Company, Ltd, was listed for the consideration of tenders for the purchase of the premises as a going concern. An order to wind-up the Company had been made; and Mr. A. Klinger had been appointed Official Liquidator, with liberty to sell the property by tender. A sale was advertised; and the petitioners (Messrs. Wallace Bros., coal merchants, of Dublin), who had obtained liberty to tender, sent in an offer for £825. The only other tender was from Messrs. Wm. & J. H. Armstrong, of Enniscorthy, and Mr. Percy S. Hutchinson, of Gorey, for £820. These offers were not up to the reserve price fixed in Chambers; and Mr. Justice Barton, on the application of Counsel for Mr. Joyce (a shareholder), adjourned the matter to enable the Official Liquidator to call a meeting of shareholders to consider the position of the Company. Mr. Klinger stated in an affidavit that, at the meeting, it was suggested that if Messrs. Armstrong and Mr. Hutchinson would increase their offer to £1000, the shareholders would recommend them as purchasers. The business of the Company, he added, was being worked at a loss. It was now decided to put up the property in Court to the bidding of Messrs. Wallace and the Messrs. Armstrong and Mr. Hutchinson. For Messrs. Wallace £990 was bid; and for the Messrs. Armstrong and Mr. Hutchinson, £995, at which figure they were declared the purchasers. All parties were allowed their costs out of the estate.

Burnley Gas-Works Management.—Arising out of two lengthy discussions at meetings of the Town Council on the working of the Burnley Corporation Gas Department, the Gas Committee have agreed, as the most satisfactory way out of the matter, to appoint a Sub-Committee to go into the whole organization of the department and prepare a report. At the last meeting of the Town Council, a resolution demanding the calling in of an expert was withdrawn, as it was suggested the wiser course would be to let the Gas Committee first have an opportunity of discussing the question. When this suggestion was about to be moved as a resolution, it was ruled out of order, to the surprise of most members, and the discussion abruptly terminated.

MISCELLANEOUS NEWS.

PRICE OF GAS TO BE RAISED AT MANCHESTER.

At a special meeting of the Manchester Corporation Gas Committee last Wednesday, over which Alderman Kay presided, it was stated that the gross profits for the year just ended were £132,558. This is more than the Committee anticipated; but prices of residuals have gone up. To meet the deficit brought forward from last year £34,009 has been appropriated; while £42,418 has gone in the form of interest on loans, and £61,047 has been absorbed by the sinking fund. In addition, £50,000 has been handed over in aid of the rates. The effect of these payments and of meeting certain capital outlay is a deficit of £58,416. Under these circumstances, the Committee decided to stand by their previous declaration that they could not this year afford to give anything in aid of the rates.

Considering the future, the Committee estimate that, with gas at the present prices, there would be a reduction in income of £5750; and there will also be an advance of £87,900 in expenses. On such a basis, the estimated net result of the year's working, after making full provision for renewals and sinking fund, but without including any contribution to the city fund in aid of rates, would be a deficit of £64,558. This, added to the deficit brought forward from last year, together with capital expenditure not chargeable to loans, would raise the adverse balance on net revenue appropriation account at March next to £125,974. This being so, and having regard to the very uncertain outlook generally, the Committee feel they have no alternative but to raise the price of gas 6d. per 1000 c.ft.

The Superintendent (Mr. F. A. Price) reported that the reduction due to the operation of the Summer Time Act is estimated at 110 million cubic feet, equal to 1·77 p.ct. on the total annual consumption.

CHELMSFORD GAS-WORKS TRANSFER.

The Chelmsford gas undertaking is now a municipal concern. The Town Clerk reports that he attended at the offices of Messrs. Torr, Durnford, and Co. (the Solicitors and Parliamentary Agents of the Gas Company), and completed the transfer of the gas-works to the Corporation, and that before the transfer took place the Company had, in accordance with the arrangements made with the Corporation, retained out of the assets of the Company sums for payment of compensation, costs, dividends, interest on mortgages, and the amounts payable in respect of the winding-up. The Treasury had refused to sanction the borrowing by the Corporation of £86,056 for the purchase, and therefore interest thereon will be payable by the Corporation to the Company at the agreed rate of 5 p.ct.

In the matter of compensation to workmen, eleven have accepted £5 each in settlement of what claims they may have under the Corporation Gas Act, and two have settled for £20 and £10 each. The number of transferred employees is 51; and to seven of these who are temporarily absent on military service the Company have made certain allowances. These allowances will probably be continued by the Corporation.

Meanwhile, the Corporation have adopted various recommendations by the Engineer (Mr. E. W. Smith).

LANCASHIRE COMMERCIAL SECTION.

Resignation of the Secretary.

Mr. S. E. Halliwell, the Engineer, Manager, and Secretary of the Littleborough Gas Company, was, at the monthly meeting of the Lancashire Commercial Section of the Manchester District Institution of Gas Engineers, the recipient of the hearty congratulations and good wishes of his colleagues.

The CHAIRMAN (Mr. S. Meunier, of Stockport) said, as the members were probably aware, Mr. Halliwell would shortly be leaving the district to take up his duties as Secretary to the Bristol Gas Company; and he thought the least they could do was to offer him their hearty congratulations on his appointment and accord him a cordial vote of thanks for the valuable services he had rendered as Honorary Secretary of the Commercial Section. Having had the privilege of working in office with Mr. Halliwell for many years, he was in a position to speak with some knowledge of his abilities and of the great amount of valuable work he had done for the section. As Chairman, a good deal of work had fallen to his share; but the work involved in the secretaryship was immeasurably greater, and no praise could be too high for the manner in which Mr. Halliwell had devoted his time and energy to the duties of his office. He carried with him the hearty good wishes of every member of the section; and he hoped he would be as successful in his new appointment as in the one he was relinquishing.

The motion was supported by Mr. Whatmough (the President of the Manchester District Institution of Gas Engineers), Mr. Kendrick, Mr. Smith, and Mr. M'Nicholl, and carried with acclamation.

Mr. HALLIWELL thanked those present for the very cordial manner in which they had shown their appreciation of the services it had been his pleasure to render, and for their congratulations and good wishes. He said that the position had certainly involved a good deal of work. But it was work of an interesting character; and he considered he had derived a considerable amount of benefit from it. The work had also brought him into closer relationship with many of the members with whom it had been a pleasure to associate. He was sure he would miss the meetings of the section very much when he left the district; but if ever he had the good fortune to be in the neighbourhood of Manchester when a meeting was in progress, he trusted he might be allowed to attend and renew his pleasant associations.

Mr. M'Nicholl, of Mossley, was unanimously elected to succeed Mr. Halliwell, and heartily thanked for accepting the office.

EDUCATION AND TRAINING OF ENGINEERING APPRENTICES.

By H. A. Bennie Gray, of Huddersfield.

[Extracts from a Paper read before the Society of British Gas Industries, April 17.]

The foundation of the engineering trade is the education and training of engineering apprentices. For many years engineering employers have had in operation schemes with this objective, which make use of the existing facilities for technical education, and not to such schemes as are in vogue at (say) the works of the British Westinghouse Company and elsewhere, where the number of youths to be educated is large enough to warrant a private educational establishment.

Most engineering works now get their boys at about fourteen years of age, which to my mind is much too young for obtaining the best results in after-years. However, as the law of the land stands at present, that is the age at which children are released from school, and consequently the age at which they start work.

The usual period of apprenticeship is until the age of twenty-one years is reached, during which period it is customary for these lads to work from about 6.30 a.m. until 5.30 p.m., after which they can, if they wish, attend evening classes either at the Continuation Schools or at the Technical Colleges. Think what this means. A lad (nay, I shall say a child) of fifteen years roused from bed at any time between 5 and 6 a.m.—in the winter months, too, for our Continuation Classes are held during the winter season—and set to work from that time until evening, with two brief intervals in which to stoke up his body to maintain the supply of energy necessary for carrying out his work. On release from the shops, he can attend Evening Classes. But how many boys have the energy left to face a two-hours' lecture on mathematics, mechanics, or other kindred subject; and of those who have the energy to go, have they the mental capacity to benefit therefrom when physically tired? No; the system is wrong from the very foundation.

I am speaking not without full knowledge of the facts. I speak with the knowledge that comes from the experience of actual training under the system I have just referred to. Furthermore, I have during the past five or six years visited our own apprentices at their classes in the various Evening Schools, and have always come away feeling that "the spirit is willing but the flesh is weak"—weakness born of physical exhaustion.

Of course, it is open for anyone to say that there are day classes available for further education. Quite so; but how many parents can afford education to such an extent for their children? And surely no one will suggest that the mere possession of wealth should be the "Open Sesame" to education. Education is the hereditary right of every child in the country. With education come that fuller knowledge of life, that craving to attain to higher things, and that feeling of independence which is the prerogative of our race.

We all know that humanity is divided into two classes—leaders and followers; and when opportunity comes along, nothing on earth can keep the leaders down. But suppose our educational system so altered that the standard of learning was considerably higher, and that everyone had the same facilities for reaching this higher standard, how much better men would our leaders be, and how much better would our followers be? I say emphatically that money cannot measure the value of the increment.

Fortunately, the day is past when employers treated the Technical Colleges with indifference, as can be seen by an examination of many of the College Calendars, where lists of employers are given who are willing to grant special educational advantages to their apprentices. This arrangement is undoubtedly a good one; but we want to see it carried still further. In fact, we want it carrying to the point where every employer will make it his business to educate each of his apprentices according to his [the apprentice's] capabilities, and so ensure that when the lad reaches his majority he will be trained to a maximum capacity, both practically and theoretically.

It is quite within the bounds of possibility to expect that certain employers of labour will object to be saddled with the extra expense entailed in the technical education of their apprentices; but looking at it from the purely pecuniary standpoint, the results will more than justify the expenditure, as can be seen from the results obtained at the private educational establishment previously referred to.

We must, however, also view it under another light, and consider the question from the national standpoint. No one will question but that during the present war the youth of the country have done a service which is not measurable in hard cash; and it behoves us to see that the rising and future generations are trained in such a manner as to ensure that the young lives which have been laid down for the Empire have not been laid down in vain.

There are difficulties many and great in the carrying-out of such drastic alterations in our workshops to work a scheme of this description. But we are here to overcome difficulties; and we shall surmount any obstacles which may come in the way of our achieving success in this direction.

The first thing to consider is, How the problem can be tackled effectively. To simply raise the age for leaving school would impose a hardship on the majority of parents, unless some allowance towards the upkeep of the child was made by the Government. And although, from a high Socialistic point of view, the State should be responsible for the children of the country, still we have hardly reached that ideal stage yet, nor are we likely to do so for many years to come. In the meantime, we must be up and doing.

There is not the slightest doubt but that employers are quite prepared to do a great deal in this question of education; and as an indication of the lines that might be adopted in the various centres, I purpose detailing the procedure recently set in operation in my adopted town. These suggestions are not put forward as being new by any means, but more with a view to stimulate your interest in the subject, and to point to a pathway which can be varied to suit any existing circumstances.

Huddersfield is primarily a woollen town; and that the Engineering Department of the Technical College is of secondary consideration is, therefore, hardly to be wondered at. One of the greatest difficulties we have had to contend with in inducing apprentices to attend college has been the opposition of parents who had been students there in their youth, and who assured us that the Engineering Department is now in the same condition as it had been in their early days. This feeling can undoubtedly be traced to the apathy of the Governors towards the Engineering Department.

Certainly the space available for class rooms, and the dungeon-like laboratories, were enough to scare away all but the most determined students. Having struggled against this feeling for many years, the engineering employers of the town decided to form an Association to equip (at their own expense) an up-to-date Engineering Department, provided the authorities would find ample space for the purpose. An influential Committee was appointed; and here I might add that the Federated Trades extended their whole-hearted support to the scheme, and appointed representatives to sit on the Committee.

Within six weeks of the formation of the Association, the Governors of the Technical College had asked the Committee, with the addition of four Governors, to act as a Sub-Committee to run the Engineering Department entirely. This procedure, as before stated, is not new; but the point I wish to illustrate is that the educational authorities at the present time are only too ready to welcome any practical suggestions and assistance for furthering the interests of education. I am sure that the Huddersfield educational authorities are not alone in this respect.

By providing fully equipped laboratories, &c., and laying down a suitable course of instruction, it will be possible to offer adequate technical training to our apprentices; but, in addition, we shall have to find the time for such training during working hours. [As a basis to work on, the author gave particulars of the system in vogue at the works of the British Westinghouse Company, but the details of which would necessarily vary in each individual case.]

Continuing, he said: The cost of this education works out at about £2 15s. per head per annum, of which about half is the wage of the apprentice during his class hours. It is a scheme which has been found very effective, and (with modifications) it could be adapted to work it in with the re-equipped colleges previously referred to.

It must not be assumed that the scheme forms an entire education for apprentices. It is run more with a view to fostering the desire for further learning; and so well is this object achieved that quite a large percentage of the boys attend evening classes at the School of Technology, in addition to attending the workshop school through the day. The arrangement also gives employers an opportunity of studying the special leanings and qualifications of each apprentice in his works, and enables him to put his finger on the most suitable man for any special requirements which may arise from time to time.

From session to session it will be seen which boys are worthy of further education; and so by careful selection, we shall, in the later years of a lad's apprenticeship, be training theoretically only those who are capable of assimilating the knowledge put before them, and shall thus avoid needless expenditure. The best lads among those so trained can, by means of scholarships endowed by the trade, be afforded the opportunity of obtaining a more advanced engineering education at the day classes of the technical colleges; and finally those whose leanings carry them in that direction can be transferred to Universities to carry out the very necessary research work in which we have allowed ourselves to lag so far behind our competitors.

Having outlined the technical side of the question, let us now turn our attention to the practical side for a few moments. With the introduction of extreme specialization, apprentices have not had the same opportunities of obtaining that all-round engineering knowledge which our older engineers possess; and we must admit, unfortunately, that a few employers of labour have exploited boys for their own selfish ends, without any consideration as to what might be their lot in after-life. It should be the duty of every employer to see that his apprentices obtain the very best opportunities of becoming skilled craftsmen in whatever branch of the trade they take up—not only skilled in the manipulative sense, but in the knowledge of what can actually be turned out by any particular machine tool.

If, as has been done in some works, both in this country and America, a part of the shop equipped with various types of tools can be set aside for the training of the apprentices, so much the better. But this can only be done in large works, where the number of apprentices is great enough to justify such an expenditure. Speaking generally, however, the average works would not be able to deal with the question on the above lines; and, this being the case, it would be necessary for them to combine, and form a special department at the local technical college, equipped with the standard type of machine tools. Here their lads could be instructed in the use of such tools, and have an opportunity of seeing actually what can be done with them in skilled hands. Thus, when the boy returned to the shops, he would feel ashamed to stand beside any machine which was not running up to its maximum output.

In addition to this, there should be a highly skilled tradesman in each department, whose sole duty would be to study the character, and supervise the work, of the apprentices under him. By careful and tactful handling, he would be able to foster in the lads a desire to excel in manipulative skill—thus using both brains and hands to maximum advantage.

The results of this combined training in after-years would be that the output per man would be so greatly increased that, instead of our working week being from 50 to 54 hours, it could easily be reduced to 40 hours, and the earning power of the man would also be increased proportionately to his output.

Although it is not possible or desirable to allow every apprentice to have the round of the shops, still there should be an interchange of apprentices between the pattern shop and foundries, and also between the machine shops and the fitting and erecting shops. This would create greater sympathy between departments, and result in the removal of many of the petty jealousies which exist in all shops, and which all tend to a reduction of output.

As a further inducement for apprentices to strive to excel both in

their practical work and technical training, all vacancies in the drawing and estimating offices should be filled from the shops. The lads would thus have a further incentive to become thoroughly proficient in their trade, as it will generally be admitted that, even at the present time, the drawing office is a powerful argument in persuading boys to attend the evening classes.

These suggestions should form a basis on which to work. But, of course, modifications would have to be made to suit the particular requirements of each firm or district; and if every engineering firm decided to become associated with some such scheme for the furthering of the training of their apprentices, I feel sure we should solve more of our present-day difficulties than we imagine.

Discussion.

The CHAIRMAN (Mr. H. M. Thornton) said they must all be very delighted that they had their future President (Sir Robert Hadfield) with them. He was quite sure they had all been pleased with the paper read by Mr. Bennie Gray. In it there was a great deal of food for thought; but much of it would be impossible to fully discuss, and arrive at any conclusion upon, in the short time available, but no doubt many would like to take part in the discussion. To their visitors, they gave a very hearty welcome, among whom he was glad to see their Past-Presidents, Mr. Dugald Clerk, D.Sc., Mr. Balfour Browne, K.C., and Professor Arthur Smithells; also Mr. Milne Watson, Mr. A. E. Broadberry (President of the Institution of Gas Engineers), and Mr. F. W. Goodenough. The first thing they had to do was to propose a vote of thanks to Mr. Bennie Gray for his paper. He would ask their President-Elect to propose the vote, and Mr. George Clark, of the Bryan Donkin Company to second it.

Sir ROBERT HADFIELD, F.R.S., D.Sc. (President of the Society), said he was delighted to hear Mr. Gray's paper. Generally, it breathed a spirit of hope, and that was what was wanted. English people had been rather too pessimistic the last two years. He believed this was, to some extent, the secret of some of the faults they had shown. While pessimism might go too far, so might optimism, and he really thought that they had not estimated at their true values the duty and place in the world of the British nation. Take, for example, the result of recent events. Our American brothers considered they were not going to get much benefit out of the new situation which had arisen between them and our country. For instance, the speaker had recently received cables from America asking us to help them on many important points. This did not look as though this country was played-out. The paper, as he said, breathed a spirit of hope; and there were better things in store for those people whom they called the employees. He had great sympathy indeed with those who worked for their daily bread. Much of the work they did was laborious and uninteresting. In a remarkable interview that was published in one of the London daily papers not long ago, it was said that they had not recognized the true value of the material that they had in this country. Mr. Gray threw out many valuable hints as to how to make the best use of this splendid material. He congratulated him upon the broad-minded way in which he put forward these suggestions. He (Sir Robert) was recently discussing this very point with some of their works managers and officials, and had in mind as to whether there was not something they could do to encourage the workmen, not merely from the point of view of getting out more work, but that they should take an intelligent interest in their daily round and common task. He had come across the same spirit in the new Minister of Labour, Mr. John Hodge, whom he had had the pleasure of meeting on several occasions. For example, in an address at the Rotary Club, Mr. Hodge asked "Why cannot we make our workmen more intelligent?" He was referring to the steel workers—those who dealt with the melting, rolling, and forging of steel. Not long ago he (Sir Robert) had been talking with some of his people about the great waste of fuel. It mattered not how perfect their furnaces were, if their men did not know how to use them they could not expect to get the best results. This proper use could not be expected unless the men had been previously trained in, at any rate, some of the rudimentary laws relating to combustion. He agreed with Mr. Hodge that the working men should be given a better chance to show what they were made of. He hoped, therefore, that before long this point of view was going to be further tested in his firm's own works. He suggested that a copy of Mr. Gray's paper should be sent to Mr. F. B. Stead, the Secretary of the Special Committee on Science in the Educational System of Great Britain, at the Education Board presided over by the President of the Royal Society, Sir Joseph J. Thomson. If the Society showed the Education Board that practical and sensible suggestions were being made to deal with this important question, he felt sure good would result. Mr. Bennie Gray had spoken of reducing the working week from 54 to finally 40 hours. This, perhaps, at first sight seemed to be Utopian. He (Sir Robert) could speak from 25 years' experience of a 48 hours' week; they had 15,000 men at work under that scheme. It showed what could be done. A very eminent authority in this country—a man for whom he, and, he was sure, every one present, had the greatest respect—Sir William Lever, of the Sunlight Soap Works, in the pamphlet he had written, had chosen the same number of hours that Mr. Gray had put forward. Sir William saw no reason why the working week should not be brought down to the number mentioned. One of the means of bringing this about was the point submitted by Mr. Gray in his paper—the education of the worker. He had pleasure in proposing a hearty vote of thanks to the author.

Mr. GEORGE CLARK, in seconding the vote of thanks proposed by the new President, said the question was a very difficult one to try to discuss because it was so full, and had so many sides to it that one scarcely knew where to start, and where to leave off. Undoubtedly, the writer of the paper struck the right note by attacking the question of the training of the earlier apprentices—those between the ages of 14 and 16. In public life they were taking care of the children, and then went on to the elementary school instruction. But then from the age of 14 to 16 there was no door open to them but the evening continuation schools. He was speaking especially of those districts that were full of engineering and mechanical work; and it seemed to him more than ever necessary that this question should be considered by the educational authorities in those centres. He was particularly thinking of the higher education committees set up by the education authorities under the various county councils and in the Universities, who were naturally influential in the large centres. There were many of the smaller towns in the country which wanted to do something for their apprentices, but the towns were not large enough for the co-operative principles laid down by Mr. Gray. If they could only induce the Technical Education Committees to get on to the right lines in the large industrial centres, then they would provide means for the apprentices in the smaller communities. He should like a copy of the paper sent to Mr. H. A. L. Fisher, the President of the Board of Education. If anyone knew the needs of the industrial districts, it was Mr. Fisher. He had been Vice-Chancellor of the University of Sheffield. If also they could have copies forwarded to the educational councils throughout the country, it would enable them to give this great question the consideration it demanded.

Prof. ARTHUR SMITHELLS said he responded very readily to the kind invitation the Chairman had given him to speak, but he did so with considerable diffidence, because he entirely agreed with Sir Robert Hadfield that observations on a subject of this kind were much the best when made by those speaking from practical experience. The only practical experience he could speak of was that of a teacher, and as one who had studied throughout a lifetime the problem of trying to link education up with industry. He cordially endorsed all the terms of praise used by previous speakers in relation to the paper. He was quite sure, speaking as a member of the educational world, that the spirit with which the paper was animated would commend itself in the highest degree to that particular world. It was a broad, liberal, and enlightened spirit from beginning to end. There were certain points that had impressed him very much. The paper was fraught throughout with what might be called a wise conception of an educational investment; and he was sure those present would agree with him there was no more important problem before the industrial world at present than that of a wise investment in education. The conception that many people had had in the past was alluded to in the early part of the paper—that the education that should be incorporated in the life of the industrial world was something of the nature of an extra, which could be undertaken after the performance of a hard day's work. There was nothing more important in what had been said by Mr. Gray than his emphasis of the fact that they could not expect boys of tender years, after a hard day's work, to enter upon educational studies with the hope of getting any great result from it. It was a very widespread and a very mischievous delusion; and he thought he knew the origin of it. He believed the origin was simply this, that certain conspicuous examples of men who had been great inventors had confessed themselves to have been largely helped by the studies they had been able to pursue at night. But these men were exceptional men; and it was a very dangerous thing to take general doctrines for the multitude from the cases of exceptional individuals. He sometimes thought that they suffered a good deal from the very mischievous kind of arithmetic which was very prevalent at some schools—such as, "If one man could dig one yard of ground in one hour, how many yards could ten men dig in ten hours." The problem was arithmetically simple. The answer was 100. Analyzing it from the human standpoint, the answer would be found in the highest degree improbable. It was conceivable that in the first hour he (Prof. Smithells) might dig his yard; but he knew that the yield would be in the tenth hour but a small fraction of what was yielded in the first hour. All calculations of what they were going to get out of expenditure on education must be united with considerations of the kind to which he had alluded. Sir Robert Hadfield had himself endorsed a statement made in the paper as to the advantages to be obtained from the reduction of the hours of labour on efficiency of output. He (Prof. Smithells) had been sometimes tempted to think if the reduction of hours reached zero, the output would reach infinity. [Laughter.] That, of course, would be a theoretical deduction of which they might suspect a professor. But he had always considered himself a practical man. He did know there was a limit; that the limit had not always been reached; and that a sacrifice of time in the hours of labour, wisely invested, yielded mental comprehension of the problems with which men had to deal, and tended to the sharpening of their wits and increase their interest. So a reduction of this kind would be amply compensated. He was in sympathy with all that had been urged. It would be a great thing if this spirit could extend; and if the desire for this kind of education could come from industry. It was much better that it should come from industry than that it should be imposed upon industry as a plan from outside.

Mr. D. MILNE WATSON said he was not able to be present at the beginning of the reading of the paper, so that he had not the opportunity of hearing the whole of it. What he did hear of it was most interesting. Some years ago, the Gas Light and Coke Company realized the value of training apprentices in the way suggested. They had been in the habit of taking on every year some twenty-four boys in conjunction with the London County Council, and training them in a special shop that they had erected. They found it almost impossible to expect these boys after a hard day's work to attend lectures and classes, and so they had arranged to let the boys attend the Westminster Polytechnic (which was quite near their offices) in the afternoon, deducting the educational time from the hours of work, and thereby enabling them to go fresh to their study. This, in his opinion, was of the utmost importance. It was impossible to expect a growing boy, with his desire for a little relaxation—and it was a most healthy desire—to go away to classes after an eight-hour day's work. Anyone adopting a similar scheme would find it absolutely necessary to be prepared to take the time of study out of the working hours of the day—at least, during the first year or two of the boy's apprenticeship. He might say they regarded the system as an emphatic success. The boys, from the first, were welcomed by the senior men, because they knew more about their work than boys without any training in their craft. These boys invariably took high places in the various examinations that they went in for at the Polytechnic and elsewhere. One also noticed that the boys soon took a very different view of their work, and were harder workers and much more amenable to discipline. This was all much to the good. Quite recently the London County Council asked the Company to try a new scheme which had great possibilities. The London County

Council teachers now came to the Company's offices after the work of the day had stopped, and something like 125 to 150 young people, mostly between 15 and 20 years of age, attended classes in English, French, arithmetic, geometry, and various other subjects which would lead them to become better workers from the commercial point of view. He was sure this was a move in the right direction. Whoever started the idea was much to be congratulated upon it. It had great advantages. The girl or lad had a cup of tea provided by the Company, and she or he went straight from that into the class room. Once outside the building, they could not expect them to walk a mile or two, tired and hungry, and then go back to the London County Council School. If the Company provided a cup of tea on the spot, there was every reason why the employees should go to the classes. The result was eminently satisfactory.

Mr. J. W. Broadhead said Mr. Gray was an authority on the education of apprentices in the district from which he came. The work done there in connection with the scientific training of apprentices was very much appreciated not only by the engineering employers, but by the technical school authorities and the apprentices themselves. He (Mr. Broadhead) had not studied the subject so closely as Mr. Gray had done; and therefore it was not surprising that he did not agree with all he said. They all agreed that it was their duty to make the very best possible of the material at their disposal, and that in the future science and practice would have to be wedded together much more closely than they had been in the past; and the rule-of-thumb practice would have to cease. He was rather surprised, however, to find Mr. Gray treating apprentices as one class. Personally, he should prefer to treat them as two classes—those who set out with the view of becoming skilled workmen, and those who set out with the view of becoming draughtsman, and making engineering a speciality. For their own works they welcomed apprentices at the age of fourteen years; but for the drawing-office, they preferred those who were better educated, and were (say) of the age of sixteen. For this reason also, he did not, generally speaking, approve of recruiting from the works' apprentices for the drawing-office. One who set out to become a professional engineer did not require the same amount of works' training that was necessary for a man who was going to earn his living as a workman. Another point was that, if they recruited apprentices from the works, an apprentice might have spent (say) three years in the works, and would only have so many more years to run before he was out of his apprenticeship. Some of this extra time spent in the works could have been spent to better advantage in the drawing-office estimating, designing, and solving various engineering problems. If possible, the training of apprentices should become general all over the country; otherwise, those who took up the work would be training apprentices for the benefit of their competitors in business, because from those firms who trained apprentices on Mr. Gray's lines there must be a fair proportion who came out of their time qualified for good positions deserving good salaries, but the firm who trained them, unless they were rapidly expanding, could not find for all of them suitable positions at suitable salaries. This meant that these men would stray away to the firm's competitors. He quite agreed with Mr. Gray that, particularly at the present time, when there was so much repetition work, apprentices were kept on one job much too long. Employers of labour should see to it that their apprentices had the same opportunity of learning their craft as their forefathers had in the old days. He did not agree with Mr. Gray that a youth who had been thoroughly trained in a school and workshop when he came into the fitting-shop would not be satisfied unless he turned out the maximum of which a machine was capable. The trade union would prevent the maximum of the machine being turned out. The apprentices were not left alone till they joined some society. If inquiries were made in their workshops, it would, he thought, be found that most of the apprentices were members of a society. It would be to the advantage of everybody if working hours could be reduced. There would be less wear and tear, standing charges would be reduced, and the employer would profit. But the output would have to be correspondingly increased. At the present time, the slowest man ruled the speed of the shop. The fact that they could not speed-up some men presented a problem that would prevent working hours being shortened to anything like the extent indicated.

Mr. F. J. West said all would agree that not the least among the post-war problems was the education of the apprentice. It was useless to talk of the work of the future if they neglected the education of the men who were to carry forward this work. He believed that, in the training of the engineering apprentice, they must have two schemes—one covering those who were to take technical and administrative positions, and the other those who were to become highly skilled workmen. The former scheme must be open to those in the latter category, in order to encourage and bring out the best of their workmen. One of the great difficulties in the way was that their professors and lecturers on education were scarcely agreed as to what was the best training for those who would be called upon to occupy technical and administrative positions. One side suggested they should take a college course of several years, and then go into the engineering workshops. The other side suggested that the engineering shops should be taken first and then the college course. Both these schemes were open to objections. The one he personally favoured was one that had been partially adopted in Manchester, under which scheme the technical and practical training went on side by side. They had a scheme at the Manchester School of Technology by which those who were to occupy technical and administrative positions in their workshops could spend one day in the Technical Schools and the remainder of the time in the workshops. This scheme he hoped would be extended. They had another scheme which had received much attention throughout the country. Junior Technical Schools had been established, and attracted lads from the ordinary Council Schools. On reaching the age of 14 the boys spent twelve months in this school; and employers in the district had been circularized, and asked to take boys from this course into their workshops. Upon commencing his apprenticeship, the boy was allowed to continue at the Technical School on one day in the week

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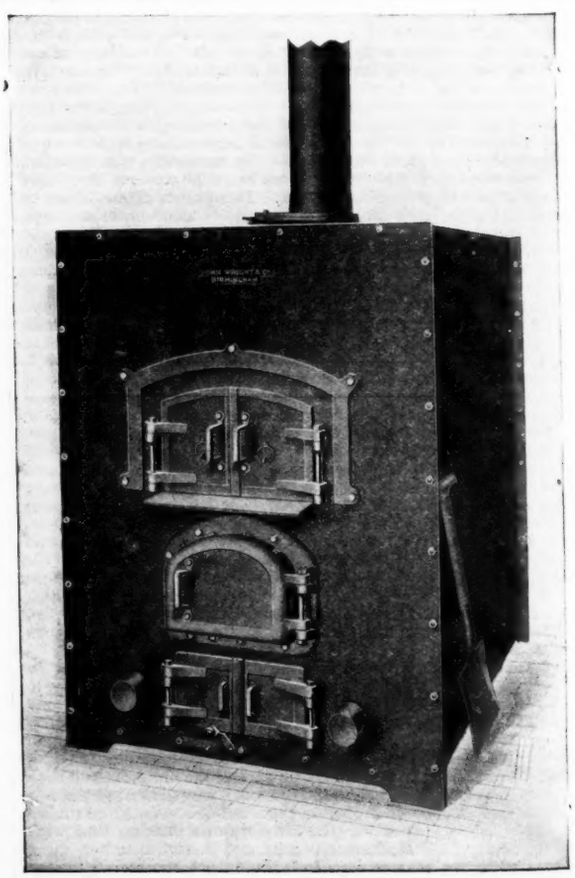

without deduction from his wages for the time he was absent from his work. In his case, the boys were allowed to continue this course on Mondays. He thought employers must look to the education of their apprentices from a liberal standpoint. They must be prepared to allow their apprentices to attend these courses, and not deduct anything from their wages during the time the boys were away from their employment. He had almost reached the stage when he was prepared to condemn evening classes. It was no longer possible to expect the boys after a long day's work to put in two or three hours in technical schools to further their education. Only one other point with regard to the attitude of the Ministry of Munitions in reference to the welfare of apprentices. During his presidency of the Manchester Engineering Employers' Association, he was approached by a representative of the Ministry, and asked to be allowed to put before the employers a welfare scheme for apprentices. It was a scheme that suggested that in every engineering works or manufactory, some official should be specially allocated to consider the welfare of the boys—not only their welfare from the point of view of their education at the technical schools, but to examine into their progress and industry, as well as their efficiency for positions in the workshops. The Ministry had taken the lead in this matter, which was a sign that the Government recognized that the education of the apprentices was one of the most important things in the future of the industry of this country.

Mr. A. E. BROADBERRY (President of the Institution of Gas Engineers) said he was glad to have the opportunity of adding his congratulations to Mr. Gray for his excellent paper on a very important subject. He also wished to add his thanks for the privilege of being present to listen to the very interesting discussion. He did not know that he could add much to what had already been said to make the paper much more valuable than it was. He thought Mr. Gray had expressed some high ideals. If he might criticize in one way, he should like to say that, as Prof. Smithells had pointed out, the scheme depended for its achievement upon the spontaneous desire which had produced such good results in Scotland. Whether in England they would reach that same high standard from purely voluntary effort, he had his doubts. Mr. Milne Watson had told them of the excellent work that the Gas Light Company had been doing. There was nothing to prevent him inducing some of Mr. Milne Watson's trained gas-fitters to come away from the service of the Gas Light and Coke Company. [Laughter.] The thing must be made absolutely general if it was to hold together at all. It must not be left to one or two to do this important educational work, and for others to take advantage of what they had done. The fabric which they were building up needed very strong cement to bind it together; and he thought it would be the cement of compulsion. He did not believe voluntary effort was going to achieve very much. There would to his mind have to be compulsion in three directions: (1) Compulsion on the apprentice to attend the classes. (2) Compulsion on the employer to grant the time necessary for the classes, and by making it penal for him to employ any lad who did not regularly attend such classes. (3) There would have to be compulsion on the trade unions, so that they might lend their weight to increase the output per man rather than decrease it.

Mr. J. H. BALFOUR BROWNE, K.C., said the part of Mr. Gray's paper in which he was much interested was the author's suggestion for making the human instrument in our manufactories a more suitable tool for the work it had to do. That was of importance from the employer's point of view. Prof. Smithells had said this would be a "good investment." "Investment" had a sinister sound in these days. He also said he was glad this movement was coming from industry itself. He (Mr. Balfour Browne) questioned very much whether it was. The last speaker had indicated that, in his view, there would have to be compulsion. Remember what this meant! In making this instrument the best possible in producing their skill in the highest possible way, they were striking at the very root of socialism. This was why he put in a dissentient note. Workmen were looking at this too much from the employees' point of view. Part of the creed of socialism was that in future the workmen should not be paid according to skill, but according to needs. If this was so, what was the meaning of this attempt to produce skill in the workmen, if they were to endow idiocy? Remember what they had to deal with was not merely education, but the organizations of labour. That was a very serious outlook for British industries.

The vote of thanks was heartily agreed to.

Mr. BENNIE GRAY, replying to the discussion, first thanked the speakers for their appreciative remarks. Proceeding, he said Sir Robert Hadfield strongly showed his favour for the reduction of hours, which was a pleasing thing. He knew that 48 hours had been in existence in a large number of trades in this country; and it was probable that, had it not been for the outbreak of war, it would have been in the engineering trade by now. As to Prof. Smithell's remarks, there was a delusion about night classes, and there always had been. As he said in the paper, he knew what it was. He had had experience of it, and had had many sleepless nights on account of it. The system that Mr. Milne Watson had at the Gas Light and Coke Company was a very interesting one, and one which the British Thomson-Houston Company and the Westinghouse Company had applied. There were a number of engineering firms in this country who had all sorts and conditions of systems at work. In his official capacity in the Association at Huddersfield to which he had referred, he was at the present time gleaning information for his Committee; and out of about eighty firms with whom he was in touch, he had had replies from about forty. He should say that 90 p.ct. of these firms had some scheme in operation for their apprentices. What, however, he wanted to keep in view principally, was co-operation between the whole of the trades of the country. That was the point of the whole system. Mr. Broadberry referred to the fact that he could easily take Mr. Milne Watson's trained men; if Mr. Broadberry was training men in the same way, there would then be equal honours. As to Mr. Broadhead's remarks—well, naturally, he (Mr. Gray) did not agree with them. Why should

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the brilliant boy be condemned because his parents had not the money to keep him at school until he was 16 years of age? Again, in his opinion, the draughtsman who had been through the works was better than the draughtsmen who had not been through them. Regarding the number of boys trained, Mr. Broadhead said he would be training more than he could usefully find employment for. The number of boys who were trained by a firm to a certain extent depended upon the progress the firm were making. The boys would be valuable to the firm who were making progress. One of his main ideas was to get at the roots of trades unionism, and kill the evils of it by education. The dual system Mr. West referred to was quite a necessary thing; but he did not deal with this side of the question at all in the paper—simply preferring at the initial stages to set the ball rolling, and then afterwards to subdivide the scheme into what was required. While the junior technical schools were being pushed very much by the Education Department just now, one of the things he should like to see was the employers acting in an advisory capacity. The practical man who was in constant touch with the work could give the professional man some useful information in return for the useful information to be obtained from the professional man. The welfare department was a good idea; but one of the difficulties he foresaw was that the duties of the supervisor as laid down by the circular issued by the Ministry, would require a "super-super-man" [Laughter]. To remove one of the biggest drawbacks to the education movement for apprentices, they wanted to get rid of the town council element on the education authorities. They might be very estimable gentlemen; but generally their ideas of education were limited. He wished to thank Mr. Balfour Browne for his remarks. It was not good to have a discussion going all one way; and it was pleasing to hear something which prevented them flying too high.

FUEL ECONOMY OF GAS AND ELECTRICITY.

[From a Dutch Correspondent.]

The coal crisis in Holland has had a bad effect on the competition of gas and electricity. The gas industry has, though under protest, seriously endeavoured to arrange matters to meet the circumstances; but not so the electrical industry. While compelled by the Government to economize in the use of coal, the electricians have at the same time been doing their utmost to capture lighting consumers from the gas industry, under the pretext that the use of electricity meant a decrease in coal consumption when compared with the use of a corresponding quantity of gas. Through the medium of extensive advertisements, the idea has been spread abroad that the adoption of electric lighting is a matter of great national importance. Gas men, however, have also been on the alert; and a keen discussion has taken place regarding the relative merits of gas and electricity from the point of view of fuel economy.

In their arguments, the electricians generally make the mistake of not comparing gas and electrical installations of equal capacity. When speaking of lighting units, they assume that a normal inverted gas-burner of (say) 100 c.p. may be successfully replaced by an electric lamp of only 50 candles; and they base their calculations on this. An engineer of the Arnheim Electric Works calculates the coal consumption per cubic foot of gas at 1·8 kilograms; while statistics relating to the Dutch electrical industry show that the coal consumption per unit sold varies between 1·4 and 1·6 kilograms. He puts the average hourly consumption of inverted gas-burners at 4 c.ft., and of upright incandescent burners at 4·5 c.ft. Calculated on the basis of the specific coal consumption per cubic metre of gas, these burners consume 200 grammes of coal per hour for the inverted, and 225 grammes for the upright type. But then comes the mistake of putting an electric unit of 50 candles on a level with an inverted gas light of an average of 90 candles. The author even errs to the extent of taking it for granted that the gas industry has the blameworthy custom of using normal burners when they might safely be replaced by a 16-candle electric lamp; his conclusion being that an electric lamp of an average of 55 watts hourly consumption may be placed on a level with a gas-burner of normal power. Eighteen of these lamps burning for one hour consume a unit of current; and as a unit is produced with 1·5 kilogrammes of coal, one of the electric lamps consumes 83 grammes of coal an hour. By this means, he professes to show that gas lighting consumes 2·5 times as much coal as electricity.

Our electrical friend also reviews the relative coal consumption of gas and electric cooking—accepting for gas cooking appliances of modern construction an efficiency of 43 p.ct. For the distribution of a cubic metre of gas of 5000 calories, the gas-works consumed 13,000 calories in the coal substance; so that the efficiency of production and distribution is equal to 38 p.ct. The combined efficiency of production, distribution, and cooking apparatus is therefore 16 p.ct. An electric cooker or water-heater has an efficiency of 80 p.ct.; but the thermal efficiency of the generating station is so much lower than that of the gas-works that in this case there are no favourable figures to parade. As an electric unit is only equal to 864 calories, the efficiency of the electricity station is only 8 p.ct.; and the total efficiency of the apparatus becomes only 6·4 p.ct. This means that electric cooking and heating consumes 2·5 times as much coal as gas cooking.

These figures are, of course, subject to revision from the gas point of view. Modern electric lighting appliances should be compared with modern gas-fittings; and then a cubic metre of gas is equal to a unit of electricity. Regarded in this light, the relative coal consumption of gas and electric lighting would be in the proportion of 1·8 to 1·5, taking the figures of the electrician as correct. But he has altogether omitted the calorific power and intrinsic value of the tar, cyanogen, sulphur, and ammonia products derived from the carbonization of coal.

Heer Rutten, the Vice-Director of the Hague Gas-Works, points ou

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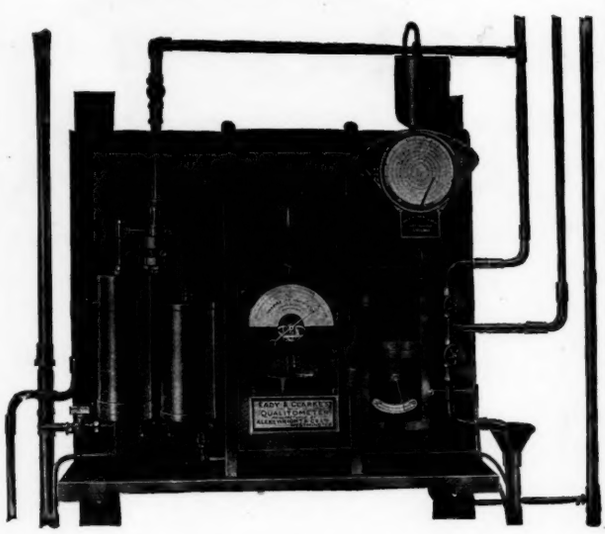

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that in carbonizing coal, 70 p.ct. of the calorific value of the coal is present in the saleable gas, tar, and coke; whereas only 13 p.ct. of the calorific value of the coal consumed is obtained in the form of electrical energy—the remaining 87 p.ct. is totally lost. Thus it is obvious that the production of electricity from raw coal, and the conversion of the current into heat, represents an inexcusable waste of fuel. It also means that real economy is to use gas for cooking.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *April* 30.

Tar products generally remain steady, the principal feature being the firmness of pitch, the value of which for export is 35s. to 36s. net per ton f.o.b. makers' works. Other products are unaltered in value.

Sulphate of ammonia is still being sold for home agriculture on the official basis of price, although the quantities are not important. The prohibition of export of sulphate remains in force.

Tar Products in the Provinces.

April 30.

There is nothing fresh to report concerning tar products, and prices remain about the same.

The average values for gas-works products during the week were: Gas-works coal tar, 20s. 3d. to 24s. 3d. Pitch, East Coast, 16s. 6d. to 17s. 6d. per ton; West Coast—Manchester 15s. 6d. to 16s., Liverpool 16s. 6d. to 17s., Clyde 17s. to 18s. Benzol, 90 p.ct., North, 10½d. to 11½d.; 50-90 p.ct., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 6½d. to 6¾d. Solvent naphtha, naked, North, 1s. 8d. to 1s. 9d. Heavy naphtha, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 3½d. to 3¾d. Heavy oils, in bulk, North, 3¾d. to 4d. Carbolic acid, 60 p.ct., East and West Coasts, 3s. 4d. naked. Naphthalene salts, 80s., bags included. Anthracene, "A" quality, 3d. per unit; "B" quality, 1½d. to 2d.

Sulphate of Ammonia in the Provinces.

LIVERPOOL, *April* 28.

The situation remains unchanged; licences for shipment abroad still being unobtainable. The values for fertilizing purposes in Great Britain and Ireland remain at £15 10s per ton to mixers and distributors and £16 per ton direct to farmers, net cash, in makers' bags, carriage paid to the required destination.

Nitrate of Soda.

This market has advanced further, and the spot quotations are now 24s. 6d. per cwt. for ordinary quality, and 24s. 9d. per cwt. for refined.

COAL TRADE REPORT.

Northern Coal Trade.

There is generally a stronger demand for coal. With more regular arrivals at the ports, the shipments are better; while the home demand is steady. In the steam coal trade, the position is more settled; and work at the collieries is fuller on the whole. Buyers are desirous of arranging for the season's exports, now near beginning. There is a brisk trade in gas coals, which has improved the position of both best and second classes. Best Durham gas coals are from 25s. 6d. to 26s. per ton f.o.b.; for second-class gas varieties the price is 18s. to 18s. 6d.; and "Wear specials" are very little changed at 29s. 6d. to 30s. Little has yet been done in the new contracts usually negotiated about this time; but deliveries are steady, and the output is well taken up. Consumers who draw their supplies by sea have high freights to meet—20s. to 20s. 6d. for gas coal Tyne to London being the current quotation; while at even this rate steamers are not always obtainable. Work is good at the gas coal pits for this time of the year; but the depleted stocks have now to be made up where possible. Gas coke is in good demand. Good qualities are quoted at 31s. to 32s. per ton; but one of the large gas companies quotes 32s. 6d. f.o.b. in the Tyne. Coke freights are shown by 45s. per ton paid to one or two of the ports of Northern France.

Wilton Corporation Gas-Works.—At a meeting of the Wilton Town Council last Wednesday, the Mayor (Mr. C. E. Marks), in connection with a report from the Gas Committee, said a somewhat large item in the accounts completed the alterations and repairs which had been in hand over the past twelve months. He thought the works generally were in a better condition than they had ever been in his time, and that the production of gas was very good, according to the material they had to use. Alderman Shepherd asked whether the improvements had led to any economy at the works. The Mayor replied that the present rate of working expenditure was 30 to 40 p.ct. less than the cost of running the works a little time back. They had attained the point they had a year ago set out for. The Town Clerk (Mr. Henry J. King): It is quite one-third less. [Early in 1916, the Council requested Mr. Norton H. Humphrys, Assoc.M.Inst.C.E., of Salisbury, to examine and report on the condition of the gas-works plant and the methods of working; and the alterations and repairs above referred to were embodied in his recommendations, and carried out under his superintendence. On account of various hindrances and delays, due to the present state of public affairs, they were not completed until early in the current year.

Davis Apparatus for Factory Canteens

The Davis Gas Stove Co., Ltd., offer the advice and services of their Chief Engineer in the planning of Canteen Schemes for any number of workpeople, and will be pleased to furnish inclusive estimates for such work.

The Davis Gas Stove Co., Ltd., 60, Oxford Street, London, W. 1.

A Gas Bus at Harrogate.

A gas bus is now running on regular service at Harrogate; the gas being stored in a bag on top. "It is," says a local paper, "anticipated that these vehicles can be run on gas at about one-third less cost than the present price of petrol. After the war this would hardly pay, when the price of petrol had been reduced to normal; but it is deemed likely that the cost of running on gas may be brought down to about one-half, so that if the experiment is a success we may have the gas-driven vehicles as a more or less permanent thing. These buses will run on the existing storage for about 12 miles, which means that the bags will have to be re-filled three times a day. This is a small matter; for the bags can be re-filled in about three minutes." In drawing attention to the matter, Mr. Frank H. Robinson (the Engineer to the Harrogate Gas Company) adds: "The paper says 12 miles per bag of gas (500 c. ft.); but when the roads are good, the bus has done 14 miles. Under similar conditions, this bus does 6 to 7 miles per gallon on petrol. Harrogate is very hilly; and better results should be obtained in more level districts. There is not quite the same speed; but, on the other hand, there is steadier running, and no miss-fires. Arrangements are made so that the driver can change to petrol, in the event of the gas being all used before the journey's end."

Nelson Gas Undertaking.

Mr. Duguld Currie, the Gas Engineer to the Nelson Corporation, presented his annual report to the members of the Town Council last Thursday. The expenditure on revenue account during the year was £54,463, or £3255 less than the estimated expenditure; while the income was £68,787, or £6136 less than the sum estimated. The result is a gross profit of £14,323, and a net deficit of £1949. With the introduction of Daylight Saving, the earlier closing of shops, and the lighting restrictions, a reduction in consumption of 4·71 p.ct. by meter consumers had taken place during the year, as compared with the last financial year. The result has been a large reduction in income from the sale of gas, and also from residual products, as the quantity of coal carbonized was fully 3000 tons less than the quantity estimated. Although £3900 has been saved in the cost of coal, the income from gas sales and residual products has suffered to the extens of nearly £6000 less than estimated. To meet the deficit on the year't working, it has been necessary to use the surplus balance, amounting to £2500. By utilizing the surplus balance, the net deficit has been reduced to £113. With the view of safeguarding coal supplies, large stocks were accumulated during the summer months. The estimates for the ensuing year are based on the assumption that the quantity of gas manufactured will be approximately the same as during the past financial year, and there will be an estimated total deficit of £6837. To meet this deficit it will be necessary to increase the price of gas for all purposes by 3d. per 1000 c.ft., and by altering the rate of discount from 3d. per 1000 c.ft. to 5 p.ct., the income from gas sales would be increased approximately £5500. He further recommends that the various grades of coke be increased by 1d. per cwt., thereby increasing the revenue from coke about £900—making a total increase in income amounting to £6400. This would leave an estimated deficit balance of £438.

Fuel Economy and Gas for Cooking.

The somewhat strange conception of fuel economy manifested by the Dutch Government Coal Distribution Board, has caused serious damage to the Dutch gas industry. The measures prescribed by the Board in order to secure the compulsory restriction of 35 p.ct., prove once more that by the governing bodies in Holland the industry is not valued at its real worth for the supply of household fuel of every description. Sufficient account has not been taken of the fact that gas is not a luxury of the wealthy, but a fuel used by both poor and rich, and in the very front rank for cooking food. The limits fixed for gas consumption have everywhere resulted in the abandonment of the gas-cooker and the re-establishment of the kitchen range. Whether this replacement of the gas-cooker by the coal-range makes for economy or for waste of fuel, was discussed by Heer Brender à Brandis (the Engineer of the Hague Gas-Works) in a recent issue of "Het Gas." The author points out that many gas consumers, for fear of exceeding the gas consumption limit, have had their coal-range lighted early in the morning, for making tea, &c.; and when once the fire is lighted, it is kept burning throughout the day. It is obvious that in such cases much fuel is wasted, as it merely serves for keeping the fire alight. The result is that with the coal-range not more than 10 p.ct. of the calorific value is utilized for cooking. When cooking with gas, however, the consumption of fuel begins at the same moment that the vessels are put on the flame, and ends directly the meal is ready. Therefore, with apparatus of good construction, an efficiency of 60 p.ct. is obtainable. The author quoted examples to show that in one case where a family used only gas for cooking, and required 810,000 calories net, the consumption of coal (allowing for the coke and tar otherwise utilized) amounted to 458 kilogrammes; but when raw coal was employed, and 810,000 calories net were required, at 10 p.ct. efficiency, the consumption of fuel was raised to 1125 kilogrammes, or two-and-a half times as much. Thus the use of gas for cooking represents real fuel economy, and the burning of raw coal is wasteful.

Benzol Recovery at Bingley.—At the Bingley Council meeting last week, the Chairman of the Gas Committee (Mr. T. Turner) said that in all probability before the next Council meeting the new benzol recovery plant at the gas-works would be in operation. The plant cost nearly £2000. The Council had asked for a promise that public notice would be given before the plant was started and the gas standard changed. A member of the Council suggested that the Council ought to supply what was necessary, so that consumers would not suffer by the change; but Mr. Turner replied that he knew of no local authority who exchanged incandescent for flat-flame burners.

Corner of one of the largest hardening shops in the Country equipped throughout with "Richmond" Furnaces.

"RICHMOND" FURNACES

Expressions of appreciation continue to reach us:—

"The Cutters treated are giving excellent results and have never been ground since putting same to work. We are confident that we have reached the end of our difficulty."

"For the Treatment of higher grade Steels, both in Case Hardening and Tempering, we have found your Furnaces extremely satisfactory."

"I may say that I have had one of your Gas Furnaces in use for the last 18 months, Annealing and Case Hardening, and I find it very satisfactory indeed."

"Richmond" Furnaces secure repeat orders and can be recommended with confidence for every Heat Treating proposition.

FOR EFFICIENCY.

The Richmond Gas Stove & Meter Co., Ltd.,
WARRINGTON & LONDON.

Dublin Gas Workers' Strike.—Some inconvenience was caused last week by a strike of forty labourers employed by the Alliance and Dublin Gas Company on a wages demand of 6s. per day. The men, however, returned to work pending arbitration in the matter.

Gas for Outside Lighting of Moving-Picture Theatres.—Mr. J. E. Bullard, in the "American Gas Engineering Journal," estimates that in the United States 2,000,000 people visit over 20,000 picture theatres daily; and he anticipates an even more rapid growth of this form of entertainment in the future. He suggests that this large number should have an opportunity of seeing a good display of high-power gas lighting, supplying the external illumination that appears to be an essential element, as they pass in and out of the entrance-doors. The theatres average at least 300 evening performances in a year, and need the outside light for two hours each night; and no frontage can be effectively lighted with less than two high-power burners using 10 c.ft. per hour each. An estimate on this basis shows a consumption of 240,000,000 c.ft. of gas per annum, equivalent, at $1 per 1000 c.ft., to $240,000 in cash. Enough has already been done in this direction to indicate standard installations suitable for each size of hall. In residential localities, a five-mantle lamp on each side of the entrance is usual; and the only variation is that three-mantle lamps may be used for the smaller halls.

Withholding a Leaving Certificate.—At the Huddersfield Munitions Tribunal, Mrs. Mary Hannah Smith, a female meter inspector employed by the Longwood Gas Company, complained of her leaving certificate being unreasonably withheld. She said the work was too great a strain, that the pay was too low, that she was responsible for money for the safety of which no provision existed, and that undue partiality was shown. Her wages were 24s., including war bonus; and she was given nothing in which to place the large amount of copper she collected. The wages were not good enough for the clothes and boots she wore out in the work. She had given a week's notice; but she said Mr. J. H. Brearley (the Manager) would not give her either a certificate or her insurance card. On behalf of the Company, it was stated that all the male inspectors were in the army; and the Company had spent a good deal in training women, who went through a probationary period, to see if they were physically fit for the work. The Company were the first in Yorkshire to substitute female for male labour of this kind; and therefore there was not yet any standard rate of wages. The women had never yet applied for a bag to carry the money. The Chairman announced that the Tribunal considered the applicant had been unfairly treated; and he was not sure the Company were not liable to a penalty from another Court for withholding the insurance card. The certificate would be granted.

STOCK MARKET REPORT.

THINGS on the Stock Exchange pursued a fresh course last week. The excess of buoyancy which was observable the previous week came rather abruptly to an end, and not a bit too soon. Reactionary swings of the pendulum are bound to be the sequel to over-pressure which unduly exalts prices. And so, last week, after a fair opening, in which some lines continued their advance a little longer while others gave warning of a check, markets underwent a chastening, but not unduly excessive, recoil. This, however, need cause no misgivings.

In Home Government issues, the War Loan and Consols were higher on Monday. Next day the check began; and on Thursday, the *ex div.* quotation was a point below the issue price. Colonials maintained their position. Home Rails were idle, and dropped for lack of support. Americans and Canadians were not very bright. Argentines were better on the whole; and South Africans were firmer. In the Foreign Market, French showed dulness at first, but amended later; Russian, Chinese, and Japanese were in demand. In the Miscellaneous group, several of the old favourites were under a cloud. Rubber was quieter and weaker; and Textiles and Oils moved irregularly. The House was closed on Saturday and is closed again to-day (being May 1), which rather handicaps business. The Saturday closing will continue until further notice.

Business in the Gas Market was more active and well distributed. The general tendency was quite good, and several quotations advanced. Imperial Continental had a slight recoil from its recent sensational jump; and Primitiva suffered from the unpardonable conduct of the local Municipality. Sheffield, which had been lowered 20 points the week before, was put up 12½, which looks as if the first move lacked consideration. In the Money Market, the rates for short loans were generally easy, and discount was fairly steady.

Bargains done for cash during the week were as follows: On Monday, Brighton and Hove "A" 105, Continental Union 37⅛, Gas Light ordinary 72, 72¼, 72⅜, Imperial Continental 90, 91, 92, 92½, 93, Primitiva 38s. 9d., South Metropolitan 77, Wimbledon 88, 88⅛, Wolverhampton 10 p.ct. 153½. On Tuesday, British 33¼, 33⅜, 33⅝, Commercial 3½ p.ct. 67½, Eastbourne "A" 96½, 97, ditto "B" 74, 74½, Gas Light ordinary 72, 72¼, 72½, 72⅜, 73, ditto preference 72, 73, Primitiva, 39s., South Metropolitan 76½, 77½, South Suburban 77¼. On Wednesday, Continental Union 39, Commercial 3½ p.ct. 67, 67½, European 11¼, 11⅝, Gas Light ordinary 72, 72⅜, 73, ditto preference 72, 72½, ditto debenture 55⅜, Imperial Continental 87, 90, Primitiva preference 52s. 6d., South Metropolitan 77, South Suburban 76¼. On Thursday, British 33¼, Cape Town 1⅛, Commercial 3½ p.ct. 67½, European, 11⅜, Gas Light ordinary 72½, 72⅝, 73, 73½, ditto debenture 56½, Imperial Continental 87, Metropolitan of Melbourne 94, 94¼, Primitiva preference 52s. 6d., 56s. 3d., 57s. 6d, South Metropolitan 77½, Wimbledon 88½. On Friday, Brighton and Hove "A" 103, Commercial 4 p.ct. 74, European 12, Gas Light ordinary 72½, 72⅝, 73, ditto debenture 56½, Primitiva 35s., 37s. 6d., ditto preference 55s., South Metropolitan 77, 78, Wimbledon 89, 89½. The Exchange was closed on Saturday.

The Bank rate is 5 p.ct., as fixed on April 5.

ANTE-WAR PRICES AND DIVIDENDS, LATEST DIVIDENDS, AND LAST WEEK'S BARGAINS.

Issue.	Share.	When Dividend.	Previous Div or Dividend and Bonus.	Last Dividend.	NAME.	Closing Prices, July 30, 1914.	Present Prices.	Lowest and Highest Prices of Bargains.
£			p.c.					
175,472	Stk.	Mar. 10	4	4%	Aldershot 4 p.c. Pref.	..	58–63	..
1,551,868	,,	April 8	2½	5⅛%	Alliance & Dublin Ord.	59–64	60–62	..
374,000	,,	July 10	4	4%	Do. 4 p.c. Deb.	76–79	58–63	..
280,000	5	April 29	7½	4/6	Bombay, Ltd.	5⅛–6⅛	4⅛–5½	..
50,000	10	Feb. 26	16	15/-	Bournemouth Gas and Water: 10 p.c.	24–30	24–26	..
383,110	10	,,	7	7/-	Bournemouth Gas and Water: B 7 p.c.	15–15½	10½–14½	..
115,000	10	,,	6	6/-	Bournemouth Gas and Water: Pref. 6 p.c.	13½–14	9½–9⅞	..
159,740	—	—	—	4%	Bournemouth Gas and Water: 4 p.c. Deb.	..	71–73	..
992,045	Stk.	Feb. 26	14	55/-	Brentford A Consolid.	261–266	83–85	..
734,920	,,	,,	11	53/9	Do. B New	204–209	80–83	..
55,000	,,	,,	5	5%	Do. 5 p.c. Pref.	109–111	83–88	..
221,400	,,	June 11	4	4%	Do. 4 p.c. Deb.	91–93	67–69	..
217,380	,,	Feb. 26	11	10%	Brighton & Hove Orig.	208–213	150–155	..
244,200	,,	,,	8	7%	Do. A Ord. Stk.	154–159	102–107	103–105
580,000	20	Mar. 26	12½	22/6	British	44–45	33–34	33⅛–33⅜
120,000	Stk.	June 26	4	4%	Do. 4 p.c. Deb. Stk.	88–90	66–68	..
245,771	,,	,,	4	4%	Buenos Ayres 4 p.c. Deb.	85–87	57–60	..
100,000	10	—	—	—	Cape Town & Dis., Ltd.	1⅛–2⅛	1⅛–1⅜	1⅛
100,000	10	—	—	4½%	Do. 4½ p.c. Pref.	4–6	4⅛–5⅛	..
100,000	Stk.	June 26	4½	5%	Do. 4½ p.c. Deb. Stk.	70–75	58–63	..
157,150	,,	Feb. 26	5	5%	Chester 5 p.c. Ord.	108–110	79½–80½	..
1,513,280	,,	Feb. 12	5/9/4	49/4	Commercial 4 p.c. Stk.	106–108	73–74	74
560 000	,,	,,	5½	46/8	Do. 3½ p.c. do.	103–105	65–68	67–67½
475,000	,,	June 11	3	3%	Do. 3 p.c. Deb. Stk.	69½–71½	52–54	..
800,000	,,	,,	4	—	Continental Union Ltd.	76–79	38–40	37½–39
200,000	,,	,,	7	—	Do. 7 p.c. Pref.	115–118	58–60	..
278,400	—	—	—	11¼%	Croydon B and C 7 p.c..	..	170–180	..
	—	—	—	10%	Do. E	..	..	..
492,270	Stk.	—	6	5½%	Derby Con. Stk.	123–125	95–100	..
55,000	,,	—	4	4%	Do. Deb. Stk.	102–104	80–83	..
1,002,180	10	July 29	10	7/6	European, Ltd.	17½–18	11½–12½	11½–12
16,313,430	Stk.	Feb. 10	4/17/4	42/-	Gas Light and Coke: 4 p.c. Ord.	98–102	72–74	72–73½
2,600,000	,,	,,	3½	8⅛%	Gas Light and Coke: 3½ p.c. max.	76–79	56–58	..
4,062,235	,,	,,	4	4%	Gas Light and Coke: 4 p.c. Con. Pref.	96–99	71–73	72–73
4,674 850	,,	June 11	3	3%	Gas Light and Coke: 3 p.c. Con. Deb.	72½–74½	55–57	55½–56½
130,000	,,	,,	10	10%	Gas Light and Coke: 10 p.c. Bonds	..	..	..
258,740	,,	Mar. 12	5	4⅛%	Hastings & St. L. 3½ p.c.	87–89	76–81	..
70,000	10	April 29	11	6%	Hongkong & China, Ltd.	16½–16⅝	8–9	..
66,600	—	—	—	9⅛%	Hornsey 7 p.c.	..	120–130	..
131,000	Stk.	Mar. 12	7⅛	7⅛%	Ilford A and C.	151–154	102–107	..
65,780	,,	,,	6⅛	5⅞%	Do. B	115–118	80–85	..
65,500	,,	June 26	4	4%	Do. 4 p.c. Deb.	92–94	71–74	..
4,940,000	,,	May 14	3	4⅛%	Imperial Continental	150–160	87–92	87–93
1,235,000	,,	Feb. 12	3½	3⅛%	Do. 3½ p.c. Deb. Red.	84–86	62–65	..
235,242	,,	Mar. 12	6½	6⅛%	Lea Bridge Ord. 5 p.c.	119–121	85–90	..
2,498,905	,,	Feb. 26	10	5%	Liverpool 5 p.c. Ord. A	211–213	82–84	..
					Liverpool 5 p.c. Ord. B	146–148		
306,083	,,	June 26	4	4%	Do. 4 p.c. Pr. Deb. Stk.	..	72–74	..
75,000	5	June 11	6	2/-	Malta & Mediterranean	4½–4⅝	3⅝–4⅛	..
250,000	100	April 1	4½	4½%	Met. of Melbourne 4½ p.c. Deb.	99–101	88–98	94–94½
541,920	20	May 28	4	6/-	Monte Video, Ltd.	11⅜–12	8–8½	..
1,875,892	Stk.	July 29	4½	4½%	Newcastle&Gatsh'dCon.	98⅛–99½	71½–72½	..
529,705	,,	June 26	3½	3½%	Do. 3½ p.c. Deb.	82–83	73–75	..
55,940	10	Feb. 26	7/14/0	7/-	North Middlesex 7 p.c.	14–15	10–11	..
800,000	Stk.	May 14	8	8%	Oriental, Ltd.	117–122	106–108	..
60,000	5	Mar. 26	10	1/-	Ottoman, Ltd.	7⅛–7⅜	2–3	..
60,000	50	Feb. 26	13	12½%	Portsea, Island B	128–131	92–97	..
100,000	50	,,	12	11%	Do. C	118–121	85–90	..
52,000	50	,,	10	9%	Do. D	..	..	..
249,980	5	April 29	8	—	Primitiva Ord.	5⅛–6	1⅞–2	35/—39/-
499,960	5	June 26	5	2/6	Do. 5 p.c. Pref.	4⅜–5	2⅛–3	52/6–57/6
521,600	100	June 2	4	4%	Do. 4 p.c. Deb.	91–93	78–80	..
—	—	—	—	4%	Do. ,, 1911	..	..	..
846,198	Stk.	June 26	4	4%	River Plate 4 p.c. Deb.	86–87	61–67	..
150,000	10	May 14	6	6/-	San Paulo 6 p.c. Pref.	10⅛–11	7⅞–8⅛	..
125,000	50	July 1	5	5%	San Paulo 5 p.c. Deb.	47–49	42–44	..
135,000	Stk.	Mar. 12	10	10%	Sheffield A	223–224	175–180	..
209,984	,,	,,	10	10%	Do. B	222–224	175–180	..
523,500	,,	,,	10	10%	Do. C	220–222	175–180	..
90,000	10	May 28	9	6/-	South African.	10⅛–11⅛	..	..
6,609,805	Stk.	Feb. 10	5/4/0	46/8	South Met. 4 p.c. Ord.	111–113	76–78	76½–78
1,895,445	,,	July 10	3	3%	Do. 3 p.c. Deb.	72⅛–74⅛	56–58	..
224,820	,,	Feb. 26	8½	8%	South Shields Con. Stk.	157–159	140–142	..
952,795	,,	,,	6	48/4	S'th Suburb'n Ord. 5 p.c.	114–116	76–78	76½–77½
60,000	,,	,,	5	5%	Do. 5 p.c. Pref.	110–112	77–79	..
135,000	—	—	—	48/4	Do. West Kent	..	..	..
187,558	Stk.	June 26	5	5%	Do. 5 p.c. Deb. Stk.	116–118	88–90	..
647,740	,,	May 14	5	5%	Southampton Ord.	99–102	77–79	..
120,000	,,	Feb. 12	7½	7½%	Tottenham A 5 p.c.	135–138	95–100	..
782,275	,,	,,	6	5⅝%	Tottenham B 3½ p.c.	115–117	68–73	..
181,255	,,	June 26	4	4%	District 4 p.c. Deb.	87–89	65–67	..
182,880	10	Dec. 30	5	—	Tuscan, Ltd.	5–6	1–2	..
149,900	10	July 1	5	5%	Do. 5 p.c. Deb. Red.	93–95	60–65	..
236,476	Stk.	Mar. 12	5	5%	Tynemouth 5 p.c. max..	108½–109½	89–91	..
					Wandsworth, Wimbledon, and Epsom—			
30,000	,,	Feb. 26	8⅜	80/-	Wandsworth A 5 p.c..	151–156	114–119	..
255,636	,,	,,	6⅝	65/-	Do. B 3½ p.c.	129–134	99–101	..
108,075	,,	,,	5/17/8	58/-	Do. C 3½ p.c.	110–115	86–91	..
352,000	,,	,,	6⅛	58/9	Wimbledon 5 p.c.	117–122	88–93	88–89½
98,000	,,	,,	6⅝	65/-	Epsom 5 p.c.	121–126	96–101	..
88 416	..	June 26	3	3%	3 p.c. Deb. Stk.	66–69	51–54	..

Wages Dispute at Doncaster.—An Arbitration Board sat at the Doncaster Guildhall last week, to consider a dispute between the Corporation and their workmen, on the question of war-time wages to meet the high cost of living. The Corporation have already given a general advance of 5s.; but the men want another 5s. After a sitting of nearly two hours, the Arbitrator (Mr. Courthope-Munro, K.C.) said the matter would be reported to Sir George Askwith, and the decision given in due course.

Meter Repairers and Exemption.—At the local Tribunal last week, the Elland Gas Company appealed for Arthur Brearley (fitter), W. A. Crowther (fitter), and F. W. Sheeran (fitter and plumber). Mr. Robert Porter (the Engineer and Manager of the Company) said the makers of the meters would not repair them; and there were a large number of meters waiting in the workshop for these men to repair. Exemption to July 31 was granted for Brearley; and Crowther and Sheeran were placed in certified occupations.

Mansfield Gas Profits.—Mr. T. Smith (the Chairman of the Gas Committee) explained at the last meeting of the Mansfield Town Council that during the past year £750 had been paid from the profits of the gas undertaking in relief of the rates, compared with £1000 the previous twelve months. The reduction did not represent that the Committee had had a bad year, but was due to the fact of the additional expense involved. One coal contract had entailed an expenditure of over £1000 more than in the previous year.

A Manufacturers' Advisory Committee.—Last month a deputation of Manufacturing Associations (including the Federation of British Industries) waited on Dr. Addison, the Minister of Munitions, to suggest that manufacturers, through their organizations, should be consulted in regard to any new orders or instructions which might be considered necessary by the Government for the regulation of labour, raw material, and manufactures. Dr. Addison assured the deputation that the Government were only too glad to welcome any suggestion whereby the necessary hardship to trade could be minimized, as far as possible. He said they had in respect of the trade union organizations a very important and most valuable committee to consult on questions affecting labour; and if the various employers' organizations would be satisfied, Ministers would be glad to consult a standing committee of (say) three or four persons whom they could trust to speak in the name of those they represented when matters arose affecting new orders, and so on. The authorities have now approved the appointment of the following Manufacturers' Advisory Committee to the Ministry of Munitions: Mr. J. Mure-Ritchie, Mr. Douglas Vickers, Mr. George Terrell, M.P., Mr. R. G. Perry, Mr. H. M'Gowan, and Sir Frederick H. Smith, Bart.

The Directors of the Oriental Gas Company, Ltd., have resolved to pay, on the 31st inst., an interim dividend at the usual rate of 3½ p.ct., less income-tax, on account of the year ending on June 30 next.

The Directors of the South African Lighting Association, Ltd., will pay a final dividend of 6 p.ct. for the half year ended Dec. 31, 1916, less income-tax at 4s. 9d. in the pound—making, with the interim dividend already paid, 9 p.ct. for the year, as compared with 8 p.ct. for 1915. The dividend is payable on May 30, and is subject to audit.

The Glasgow Corporation have discussed a proposal to renew their annual subscription to the British Commercial Gas Association. The Gas Committee recommended the renewal; but an amendment to cease the contribution was moved, and rejected. Another amendment was eventually adopted asking the Gas Committee to further consider the matter.

The Hebden Bridge and Mytholmroyd Gas Board, at their annual meeting last week, again chose Mr. James Simpson as Chairman. Mr. Simpson has been Chairman of the Board ever since it was formed, with the exception of one year. One of the reasons adduced for pressing on him to serve another year (he had previously stated his intention of retiring) was that the Board intends to complete this year the remodelling of the works, and it was advisable that Mr. Simpson should be at the head then.

NEWSPAPERS FOR NEUTRAL COUNTRIES.

The Secretary of the War Office has issued the following order:

> The public are informed that newspapers and other printed publications will not be sent to Neutral Countries unless they are posted direct from the office of publishers or newsagents who have obtained permission from the War Office for this purpose. Persons desiring to send newspapers, &c., to Neutral Countries should, therefore, give their orders for execution to publishers or newsagents who have obtained such permission.

The Publisher of the "Journal" has obtained the required permission of the War Office; and he will, on receipt of instructions, forward copies direct from the office to any neutral country.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

Gas Manager. Lytham Urban District Council. Applications by May 8.
Secretary and Collector. Carnforth Gas and Water Company.
Accountant-Secretary, Cowes Gas Department. Applications by May 7.
Working Manager. Carnforth Gas Company.
Youth to Learn Testing, &c. Alexander Wright and Co., Westminster.

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TENDERS FOR

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Blackpool Gas-Works.
Shipley Gas Department. Tenders by May 21.

Retort Arches, &c.

Briton Ferry Gas Department.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer—not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders to Alter or stop PERMANENT ADVERTISEMENTS should be received by the FIRST POST on Saturday.

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